

SERVICE MANUAL

DUAL TRACE OSCILLOSCOPE

CS-1575



TRIO

FEATURES

The Model CS-1575 is a dual trace, trigger sweep oscilloscope with 130 mm cathode ray tube mounted in a die casting panel. The vertical axis of the oscilloscope provides high sensitivity and wide bandwidth, 10 mV/div (1 div = 1 cm), DC-5 MHz (−3 dB), or 1 mV/div, DC-3 MHz (−3 dB) at X10MAG, and its sweep speed has a wide range of 2 ms/div to 0.5 μ s/div, so that this model can extensively be used for measurement of medium and short wave frequencies as well as audio frequencies. Two vertical axes can be switched lengthwise or sidewise, and also permits simultaneous X-Y observation.

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SPECIFICATIONS

CATHODE RAY TUBE

Type: 130BEB31
Acceleration Voltage: 2 kV
Useful Measuring: 8 div × 10 div (1 div = 1 cm)

VERTICAL AXIS (FOR BOTH CH1 AND CH2)

sensitivity: 10 mV/div to 3V/div ±5%
1-3 steps
Precisely adjustable in all 6 ranges
1 mV/div to 0.3 V/div ±5% (× 10 MAG)

Input Impedance: 1 MΩ ±5%
29 pF ±3 pF

Frequency Response: DC: DC to 5 MHz (−3 dB), 7 MHz (−6 dB)
DC to 3 MHz (−3 dB), 4 MHz (−6 dB) at × 10 MAG
AC: 5 Hz to 5 MHz (−3 dB), 7 MHz (−6 dB)
5 Hz to 3 MHz (−3 dB), 4 MHz (−6 dB), at × 10 MAG

Rising Time: 70 nsec

Overshoot: Less than 3% (at 100 kHz square wave)

Crosstalk: Less than −66 dB (at 1 kHz)

Operating Mode: CH1: Channel 1 only
CH2: Channel 2 only
DUAL-H: Horizontal dual trace
DUAL-V: Vertical dual trace
X-Y: X axis = CH2, Y axis = CH1

Dual-trace Changeover: Automatic changeover of CHOP and ALT (Switched to CHOP at about 80 kHz when SWEEP/TIME DIV is set to 1 ms/div or 2 ms/div, and TRIG. SOURCE is in CH1, CH2 or EXT Switched to ALT at other settings)

Phase Indication: Zero phase Lissajous' figure is displayed at the same time by phase display during X-Y operation.

Maximum Input Voltage: 600 Vp-p or 300V (DC+AC peak)

SWEEP

Sweep System: Auto free-run sweep (free-run sweep at no-signal time)

Sweep Time: 0.5 μs/div to 2 ms/div ±5%
1-2-5 step Fine adjustment in all 6 ranges

Linearity: Less than 5%

TRIGGERING

Source: DUAL: Source is automatically selected to the waveform of CH1 or CH2
CH1: Fixed to CH1 signal
CH2: Fixed to CH2 signal
EXT: Fixed to external signal

Triggering Level: Triggering levels of CH1 and CH2 are set by individual knobs

Slope: Positive only

Coupling: AC only (inclusive of EXT)

External Triggering: Input impedance: Approx. 1 MΩ, approx. 50 pF
Input voltage: 100 Vp-p or 50V (DC+AC peak), max.

Triggering Range: Internal (DUAL, CH1, CH2): 0.5 div (50 Hz to 3 MHz)
1 div (20 Hz to 10 MHz)
External (EXT): 0.5 Vp-p (50 Hz to 5 MHz)
1 Vp-p (20 Hz to 10 MHz)

HORIZONTAL AXIS (CH2)

Operating Mode:	X-Y mode is selected by DISPLAY MODE switch CH1 : Y axis CH2 : X axis
Sensitivity:	Same as vertical (CH1)
Input Impedance:	Same as vertical (CH1)
Frequency Response:	DC : DC to 1 MHz (−3 dB), 1.5 MHz (−6 dB) AC : 5 Hz to 1 MHz (−3 dB), 1.5 MHz (−6 dB)
X-Y phase difference:	3° at 50 kHz
X-Y distortionless amplitude:	More than 8 div × 8 div at 100 kHz (◆ POSITION: centered)

CALIBRATING VOLTAGE:	0.6 Vp-p ±5% (Positive square wave of power supply frequency)
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POWER SUPPLY

Power Supply Voltage:	AC 100/120/220/240V ±10%, 50/60 Hz
Power Consumption:	Approx. 22W

DIMENSIONS

Width:	260 mm (277 mm)
Height:	190 mm (204 mm)
Depth:	375 mm (440 mm)
	Figures in () show maximum size.

WEIGHT:	8 kg
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ACCESSORY:	BNC cord (two) AC cord (one) Instruction manual (one)
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OPTIONAL ACCESSORY:	PC-21 (attenuator probe) Attenuation: 1/10 Input impedance: 10 MΩ Input capacity: Less than 25 pF
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EXTERNAL VIEW AND NAME OF PARTS

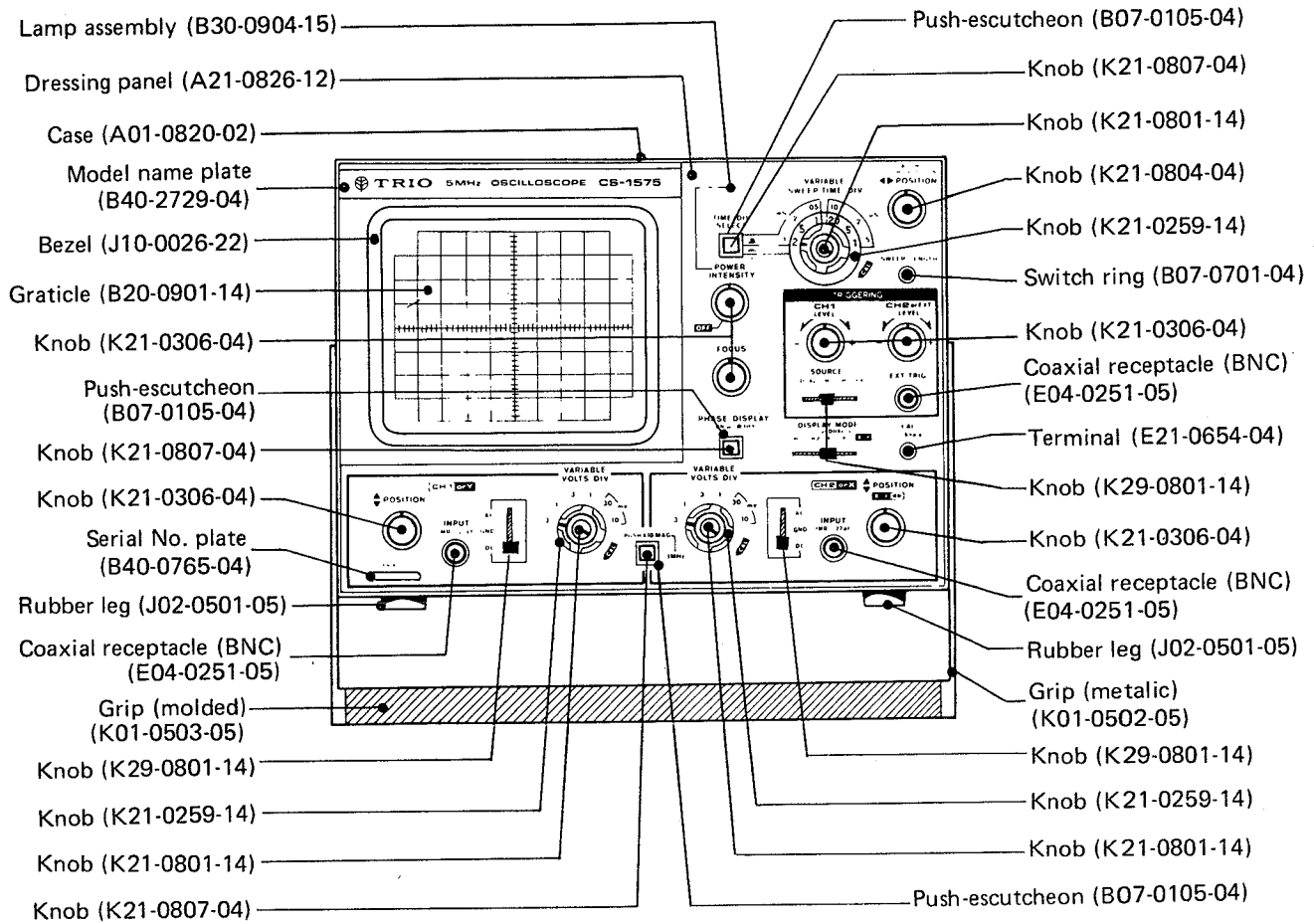


Fig. 1

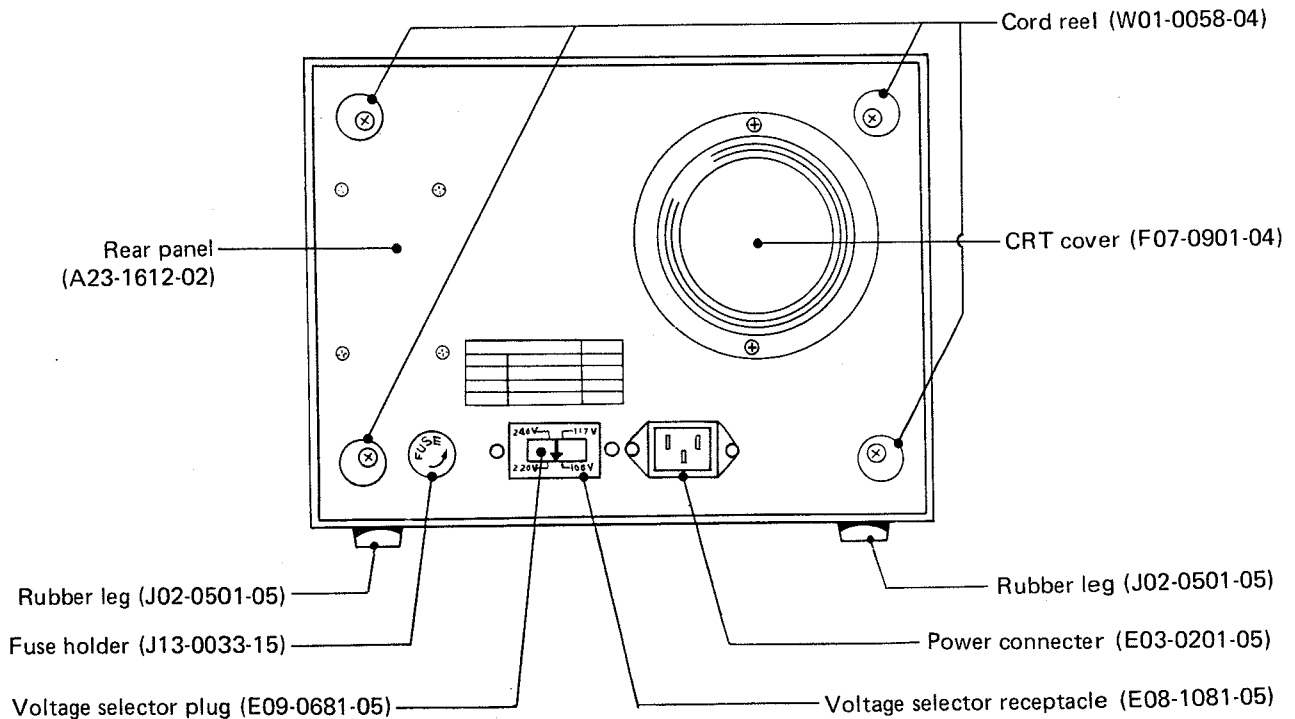


Fig. 2

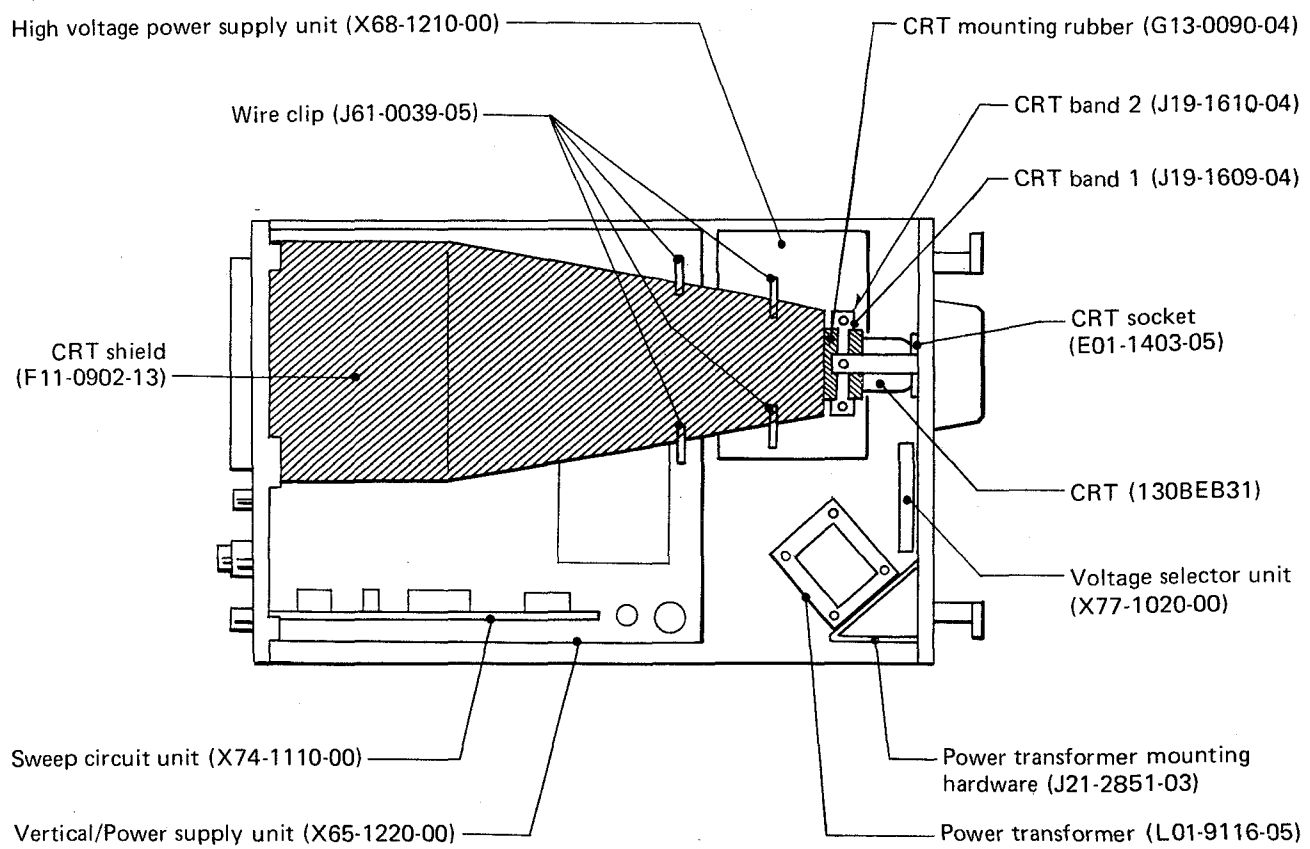
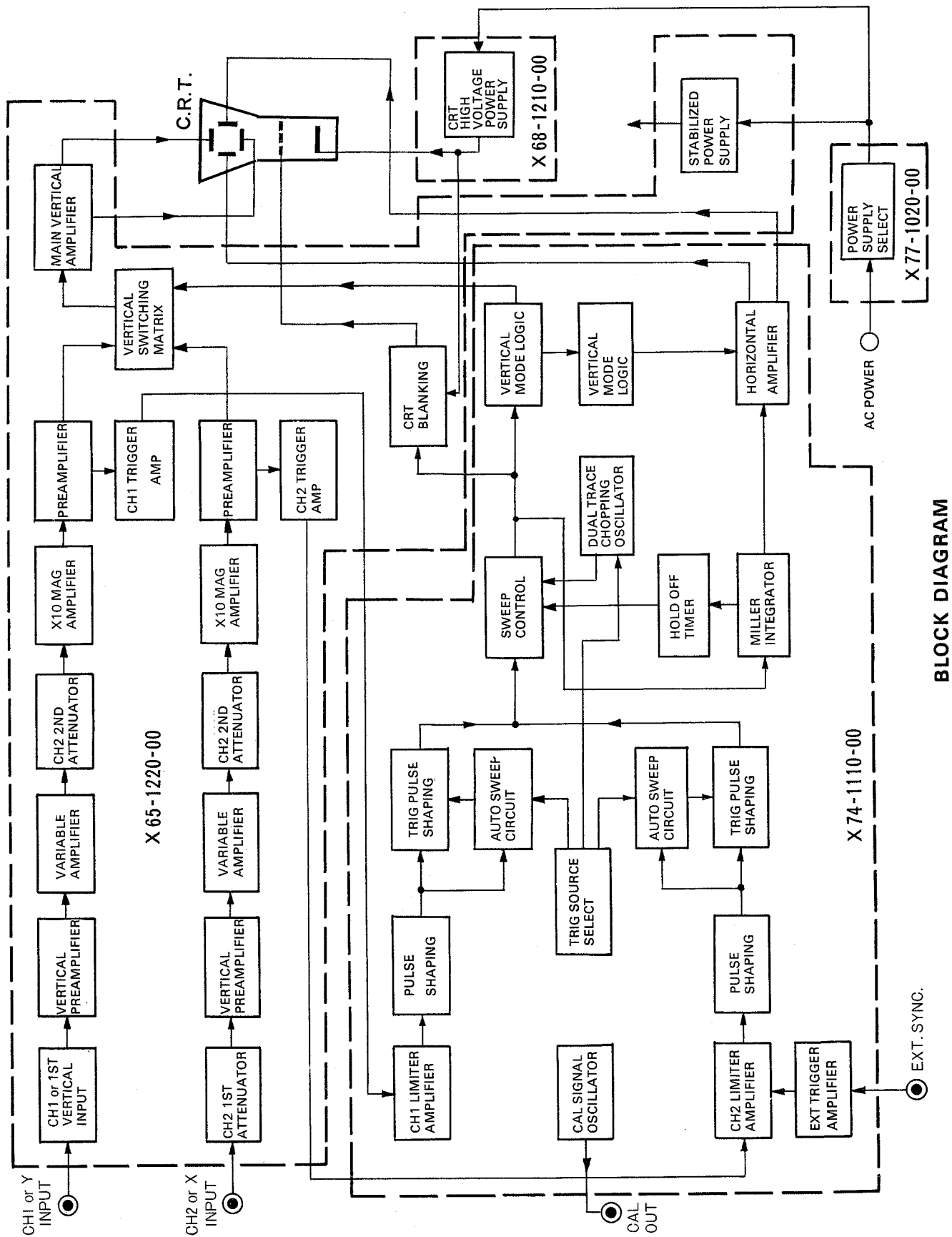


Fig. 3

CIRCUIT DESCRIPTION



BLOCK DIAGRAM

Fig. 4

CIRCUIT DESCRIPTION

VERTICAL AMPLIFIER CIRCUIT

Note: Parts symbols in () are for CH2.

The vertical amplifier circuit has two identical preamplifiers for CH1 and CH2.

A signal applied to the BNC INPUT terminal passes through the AC-GND-DC switch and is fed to the 1st attenuator where the signal is attenuated to 1/1, 1/10 or 1/100 so as to be inputted to the gate of Q2 (Q12).

Q2 (Q12) is a dual FET which has excellent DC balance against changes in temperatures and also has a high input impedance.

Q1 (Q11) is an input protection circuit utilizing the excellent diode characteristics of FET, which is used to protect Q2 (Q12) from excessive input. The source circuit of Q2 (Q12) has VR8 (VR18) to adjust VARI. ATT and DC. BALANCE.

The signal from Q2 (Q12) is fed through the emitter follower Q3 and Q4 (Q13 and Q14) to the 2nd attenuator Q5 and Q6 (Q15 and Q16).

The collector of Q5 and Q6 (Q15 and Q16) forms an attenuator to attenuate the signal to 1/1 or 1/3, while VR3 (VR13) is used to adjust STEP ATT and DC. BALANCE. VR2 (VR12) in the emitter circuit of these transistors is used to adjust the gain (VARIABLE ATT). The gain is calibrated by VR1 (VR11).

The signal from the 2nd attenuator is fed to the preamplifier Q7 and Q8 (Q17 and Q18). VR5 (VR15) in the emitter circuit of these transistors is the Δ POSITION control and VR4 (VR14) is the ADJUST control. VR9 (VR19) is used to calibrate the gain at X10MAG.

The signal from the preamplifier is fed to the "V" mode logic circuit consisting of diode gate (D3 ~ 10) inserted to the cascode amplifier Q9 (Q19), Q10 (Q20), Q21 and Q22 and the cascode junction, in which the signal is switched to a dual trace signal and is fed to the "V" main amplifier Q25 ~ 28 through the drive amplifier Q23 and Q24 where the center position of CRT is adjusted by VR6 inserted in the emitter circuit of Q25 and Q26 to prevent the dynamic range of the output of Q21 and Q22 from being biased.

The signal from the preamplifier is sampled and is fed through Q9 and Q10 (Q19 and Q20) to the trigger amplifier Q29 and Q30 (Q31 and Q32), which is further fed to sync circuit. The gain of the "X" amplifier is calibrated by VR17 while the X-POSITION is adjusted by VR16.

The signal is then amplified through the "V" main amplifier to provide sufficient bandwidth so as to be applied to the vertical deflection plate of CRT.

SYNC SWEEP CIRCUIT

The signal from the vertical preamplifier is fed through the trigger amplifier to the limiter circuit Q2 and Q3 (Q4 and Q5) where the trigger level is adjusted by VR1 (VR106). The CH2 limiter circuit Q4 and Q5 also functions as a limiter circuit for external triggering; an external trigger signal which passes through the external trigger amplifier Q21 and a CH2 trigger signal are selected by the trigger source switch and is applied to the base of Q5.

The trigger signal from the limiter circuit is shaped to square wave signal through the Schmidt circuit "A" (A') IC2a and b (IC2c and d) and is fed to the mono multi-circuit IC3a and b (IC3c and d).

The mono multi-circuit is controlled through Q6 (Q7) by the auto-free-run circuit D3 and D4 (D5 and D6) which DC-restores the output of the Schmidt circuit "A" (A'), and the trigger mode logic circuit IC1a, b and d, to produce negative pulses of about 40 nsec only at the falling time of the output of the Schmidt circuit "A" (A'). These pulses are attenuated to 1/2 by R27 and R33. Since the negative pulse is in the middle of the threshold level of the Schmidt circuit "B" IC4c and d, it inverts the output of this circuit from "H (1)" to "O". The circuits IC4a-d, Q8-11 and D13-16 form one loop to constitute a saw-tooth wave generating circuit.

At first, the output of the Schmidt circuit "B" is "H (or 1)", so D14 ~ 16 are ON and, hence, the output of the mirror integration circuit is almost 0V. This voltage is fed through the emitter follower Q8 and Q9 to the Schmidt circuit "C" IC4a and b, the output of which becomes "L (0)" and, therefore, D13 is set to "ON".

If, at this time, a negative pulse is fed by the mono multi-circuit, the output of the Schmidt circuit "B" becomes "L (0)" which turns D14 ~ 16 to OFF and thus the time base capacitor C21 starts charging through the mirror integration circuit.

The charge current is determined by the voltage set by VR5 (SWP. VARI) and VR3 (SWP. TIME ADJ.) while R44, 73, 45 and 46 are selected by the SWP. TIME/DIV switch and SWP. TIME SELECT switch; the charge current is applied through the emitter follower Q22.

The charge voltage from the integration circuit is fed to the Schmidt circuit "C" via VR103 (SWP. LENGTH), Q8 and Q9 and when it reaches the threshold level, then the Schmidt circuit "B" is driven where the output is inverted from "L (0)" to "H (1)" and at the same time D13 is turned to OFF.

When the output of the Schmidt circuit becomes H (1), D15 and D16 turn to ON and the integration circuit is discharged quickly until D14 turns to ON.

Also, the voltage charged in the hold-off capacitor C18 through Q8 is discharged slowly through R42 because D13 is OFF; this voltage is fed through Q9 to the Schmidt circuit "C" where the output is inverted and D13 turns to ON, thereby returning to the original condition.

HORIZONTAL AMPLIFIER CIRCUIT

The output of the mirror integration circuit Q10 and Q11 is fed to the emitter of Q14 through VR4 (WIDTH ADJUST), VR104 (POSITION) and VR5 (◀ POSITION ADJUST). Q14 and Q15 are cascode connected; the collector of Q15 is connected to the collector of Q16 which is also cascode connected to Q32 of the vertical axis to supply X axis signal during X-Y operation. These two cascode amplifiers are switched by IC7 through D11 and D12 to feed saw-tooth wave signal (SWEEP) or X axis signal (X-Y) to the "H" (horizontal) amplifier Q17-20, and the signal thus amplified is directly connected to the horizontal deflection plate of CRT.

DISPLAY MODE CIRCUIT

The output of the Schmidt circuit "B" is inverted by IC5d and is NAND connected through IC5c to the output of the CHOP signal generator IC5a and b to produce UN-BLANKING signal. This signal passes through VR101 (INTENSITY) and is fed to the BLANKING amplifier and, at the same time, it is inverted by IC1c to produce clock signal to IC6. Therefore, IC6 generates gate signal which switches CH1 and CH2 of vertical axis at each sweep or each cycle of CHOP signal.

PHASE DISPLAY CIRCUIT

The output of IC6 is fed to the "V" (Vertical) mode logic circuit and, at the same time, it becomes clock signal to IC7. Therefore, IC7 generates gate signal which switches SWEEP, X-Y of horizontal axis at every two sweeps or every two cycles of CHOP signal.

DUAL-H MODE CIRCUIT

When DISPLAY MODE is DUAL-H, Q12 is OFF, so the peak value of saw-tooth wave from the integration circuit is reduced to 1/2 of that in the other state. This saw-tooth wave signal is fed to the input of the horizontal amplifier circuit but the base input of Q18 of this amplifier is given from Q13. Q13 is normally OFF and, hence, the base voltage of Q18 is 5V. In DUAL-H mode, the emitter of Q13 is earthed through D22 and the emitter of Q13 is supplied with the output signal from IC6 and IC7, which is AND coupled through D9 and D10.

Therefore, the emitter of Q13 is earthed through D22 only when IC6 is in CH2 mode and IC7 is in sweep mode and thus the output signal from IC6 and IC7, which is AND coupled through D9 and D10, is applied to the base. Accordingly, Q13 is ON only when IC6 is in CH2 mode and IC7 is in sweep mode. At this time, the collector voltage is inputted to the base of Q18 through VR105 (DUAL-H CH2 ▶ POSITION).

With these signals applied, the H main amplifier outputs two saw-tooth wave signals, each having a different DC component, which are synchronized with the output of IC6, thereby displaying CH1 signal on the left half and CH2 signal on the right half sections of CRT.

BLANKING CIRCUIT

The unblanking signal from IC5c passes through VR101 (INTENSITY) and is fed to the unblanking amplifier Q45 ~ 47. Q45 and Q46 are cascode connected and its output is fed back to the base of Q45 through the current regulated emitter follower D47 and Q47 and, at the same time, it amplitude modulates the output of Q48 through D50 and D49. The output of the amplifier composed of Q48 and D49 is determined by the frequency of the DC-DC converter. The anode of D49 is connected to VR23 (INTENSITY ADJ.) to adjust the blanking position of INTENSITY.

The amplitude modulated signal is DC-restored by D51 and D52, which is applied to the grid of CRT to produce a bright line during sweep operation.

CRT POWER CIRCUIT

The CRT ASTIG electrode voltage from VR22 (ASTIC) is fully stabilized through the emitter follower Q52.

In the high tension unit (X68-1210-00), D2, Q3, T1 form a DC-DC converter circuit; the output from T1 secondary is rectified by D3 and is connected to the cathode of CRT and, at the same time, it is fed back to the regulation circuit Q1 and Q2 while feeding FOCUS electrode voltage to CRT via VR102 (FOCUS). The output voltage is adjusted by VR1 (−1.9 kV ADJ.).

POWER CIRCUIT

Power voltage required to drive the oscilloscope circuits is stabilized by the tracking regulator IC1a and b, IC2a and b, Q41 ~ 44, and is supplied through D44 ~ 46 and VR24 (+180V ADJ.).

CALIBRATING VOLTAGE CIRCUIT

The oscilloscope calibrating voltage utilizes 0.6 Vp-p square wave obtained by switching Q1 with power frequency.

MAINTENANCE

REMOVAL OF CASE AND BOTTOM PLATE

Caution:

Before removing the case, be sure to turn off the power because a high voltage (about 2 kV) is present at the CRT socket and the rear printed circuit board. Also, do not touch

the units carrying a high tension voltage with a screwdriver or hand after the removal of the case.

To remove the case, unscrew the six screws from top and side and loosen the five screws at the bottom (see Figs. 5 and 6).

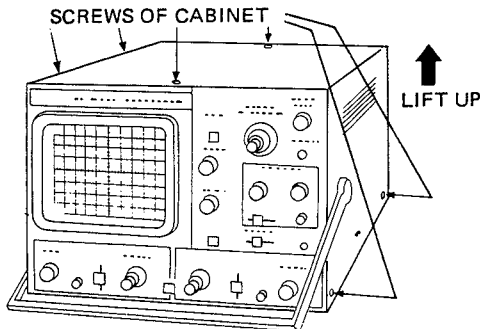


Fig. 5 Removal of case

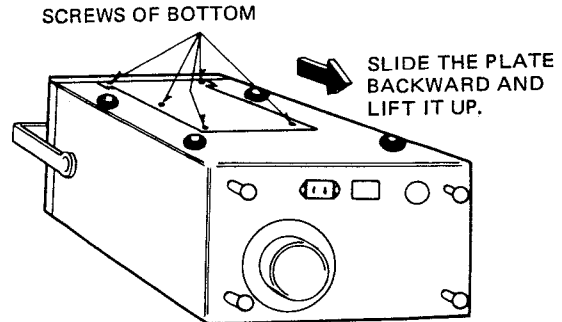


Fig. 6 Removal of bottom plate

REMOVAL OF CRT ESCUTCHEON (BEZEL)

The CRT escutcheon is fitted to the oscilloscope with 4 mold feet so that it can be removed without using tools. When removing, first disengage the two feet at the lower side as shown in Fig. 7 (pull out the ridged ends "a" from their locked positions as shown in Fig. 7). Next, disengage the upper

two feet. Note that the escutcheon should be pulled straight toward you.

When replacing the escutcheon "1", insert the projections A and A' into the holes B and B' in the dial scale as shown in Fig. 7.

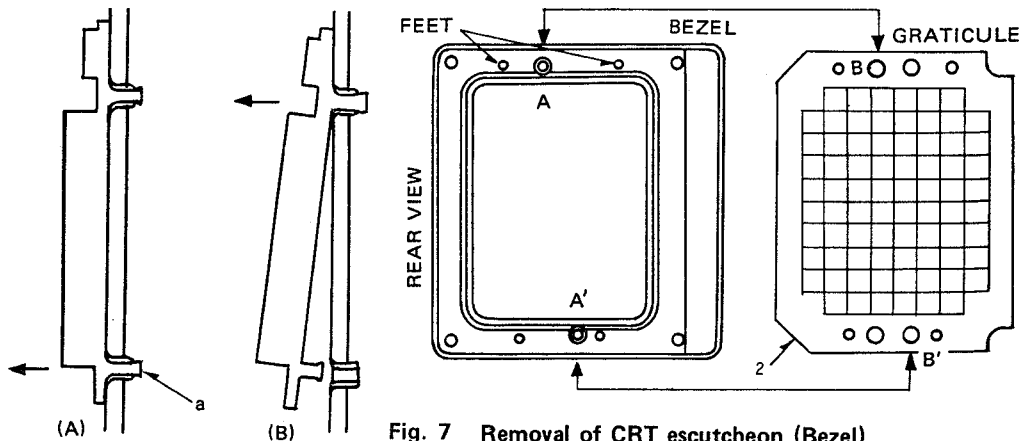


Fig. 7 Removal of CRT escutcheon (Bezel)

CRT BRIGHT LINE ANGLE ADJUSTMENT

1. Loosen the 2 screws from the CRT cover at the rear panel.
2. Turn the CRT cover and CRT will rotate together. Turn CRT until the bright line is aligned with the horizontal line of the scale.
3. Tighten firmly the 2 screws, making sure that the bright line is not deviated from the horizontal line of the scale.

Note: For adjustment, loosen the screws on the cover. Do not remove from the cover.

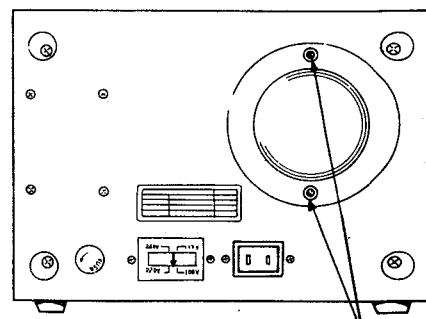


Fig. 8 CRT bright line angle adjustment

ADJUSTMENT

ADJUSTMENTS

The following points have been already adjusted. However, observe the following notes before making readjustments:

1. Calibrating the power source voltage.
2. For adjustment, use a well-insulated flat-blade screw driver.
3. For optimum adjustment, turn the power on and warm up the oscilloscope sufficiently before starting.
4. All adjustment should follow the following order.
If this order is reversed or only a partial adjustment is attempted, this may influence the other part of the circuit.
5. Accurate measuring instruments should be employed.
6. Prior to adjustments, set VARIABLE to CAL position.

POWER AND CRT CIRCUIT ADJUSTMENT

(1) Adjustment of low-voltage power supply

Check voltage at No. 1 pin of P13 and adjust VR24 for a reading of $+180V, \pm 10\%$. Then check voltages at pin No. 4, 5, 6 of P13 and confirm that these voltages are $+10V, -10V, +5V$ respectively.

(2) Adjustment of high-voltage power supply

Check voltage at pin No. 2, 3 of P11 (CRT cathode voltage) and adjust VR1 for a reading of $-1.9 kV, \pm 1\%$. In this case, use high voltage probe with an input resistance more than $100 M\Omega$.

(3) Adjustment of brightness

Adjustment VR23 so that the bright line disappears when the INTENSITY volume control index is at left in horizontal position. Adjust TC11 so that the brightness of the sweep start point is identical with that of other part. (SWEEP TIME/DIV is set to $0.5 \mu s/div$.)

Then adjust the spot with FOCUS and ASTIG (VR22).

(4) CRT centering

Short-circuit the test terminals TP1 and TP2 of the vertical final-stage and adjust VR6 so that the bright line is positioned in the center of CRT.

CH1 VERTICAL AXIS CIRCUIT ADJUSTMENT

Before starting adjustments, set the following knobs as instructed:

MODE	CH1
VOLT/DIV	10 mV/div

(5) POSITION adjustment

Adjust VR4 so that the bright line can be positioned in the center when the knob POSITION is set to the mechanical center.

(6) VARIABLE ATT DC BAL adjustment

Adjust VR8 so that the bright line is stationary when VARIABLE knob is turned. Adjustments can be made without removing the bottom plate.

(7) STEP ATT DC BAL adjustment

Adjust VR3 so that the bright line is stationary when VOLT/DIV knob is turned.

(8) Sensitivity adjustment

Apply adjusted 1 kHz, 50 mVp-p signal and adjust VR1 to obtain a 5-div deflection. Then push on PUSH $\times 10MAG$ knob and adjust VR9 to obtain a 5-div deflection.

(9) HI range adjustment with square waves

Apply an ideal 100 kHz square-wave signal with a rising time of more than $2 \mu s$ and adjust VR7, TC12, TC5 of the vertical final-stage amplifier until a high-quality wave form can be obtained on CRT.

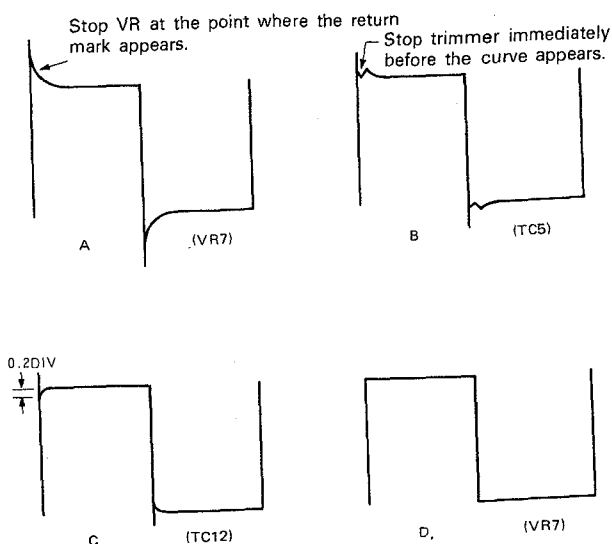


Fig. 9

By turning VR7, the overshoot portion (Fig. C) lowers and at the same time, the under portion in the middle range rises.

CH2 VERTICAL AXIS CIRCUIT ADJUSTMENT

Before starting adjustments, set the following knob as instructed.

MODE	CH2
VOLT/DIV	10 mV/div

(10) VARIABLE ATT DC BAL adjustment

Adjust VR18 (VARI DC BAL), VR14 (CH2 POS) so that the bright line is stationary when VARIABLE knob is turned.

(11) STEP ATT DC BAL adjustment

Adjust VR13 so that the bright line is stationary when VOLTS/DIV knob is turned.

(12) POSITION adjustment

Adjust VR14 so that the bright line can be positioned in the center when the knob POSITION is set to the mechanical center.

(13) Sensitivity adjustment

Apply adjusted 1 kHz, 50 mVp-p signal and adjust VR11 to obtain a 5-div deflection. Then push on PUSH X 10MAG knob and adjust VR19 to obtain a 5-div deflection.

(14) HI range adjustment with square waves

Apply an ideal 1 kHz square-wave signal with a rising time of more than 2 μ s and adjust TC10 of the vertical final-stage amplifier until a high-quality wave form can be obtain on CRT.

HORIZONTAL AXIS CIRCUIT ADJUSTMENT

(15) H. POSITION (◄►) adjustment

Adjust VR5 so that the starting point of the bright line is positioned at the left end of the effective CRT scale when the knob ◄► POSITION is set to its mechanical center. (Set CH1, CH2 INPUT to GND.)

(16) X POSITION adjustment

With DISPLAY MODE set to X-Y and X-Y ◄► POSITION (CH2 position) to the mechanical center, adjust VR16 so that the bright spot comes to the center of the CRT screen when the input to X axis (CH2) is connected to GND.

(17) SWEEP TIME adjustment

1. Set SWEEP TIME/DIV to 1 ms/div and apply 1 kHz marker signal and adjust VR4 so that 1 wave length corresponds to 1 div on the CRT screen.
2. Set SWEEP TIME/DIV to 0.5 ms/div and TIME/DIV SELECT to "ON". Then apply 0.5 ms marker signal at CH1 and adjust VR3 so that a wave length corresponds to 2 divs on the CRT screen.
3. Set SWEEP TIME/DIV to 10 μ s/div and TIME/DIV SELECT to "OFF". Then apply 10 μ s marker signal at CH1 and adjust TC1 so that a wave length corresponds to 1 div on the CRT screen.

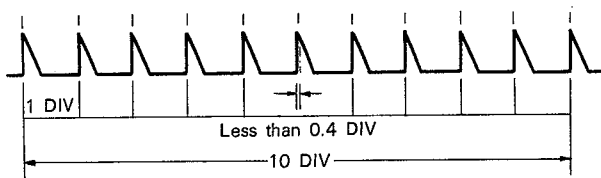


Fig. 10

(18) SWEEP range adjustment

Set SWEEP TIME/DIV to 10 μ s/div and apply 10 μ s marker signal and adjust TC1 so that 1 wave length corresponds to 1 div on the CRT screen. (Set TIME/DIV to OFF.)

BLANKING CIRCUIT ADJUSTMENT

1. Set CH1 INPUT to GND and to no signal. Adjust TC11 so that the brightness of sweep start point is identical with that of other part.
2. Reset CH1 INPUT to DC and apply adjusted 500 kHz sign-wave signal and check to ascertain that the bright line is eliminated.

INPUT CAPACITANCE ADJUSTMENTS

The following adjustments require the 10 : 1 attenuator probe. Apply adjusted 1 kHz square-wave signal and adjust the probe trimmer so that high-quality wave form is obtained. Then set VOLT/DIV to 10 mV/div and adjust TC1, TC4 until a high quality wave form can be obtain on CRT.

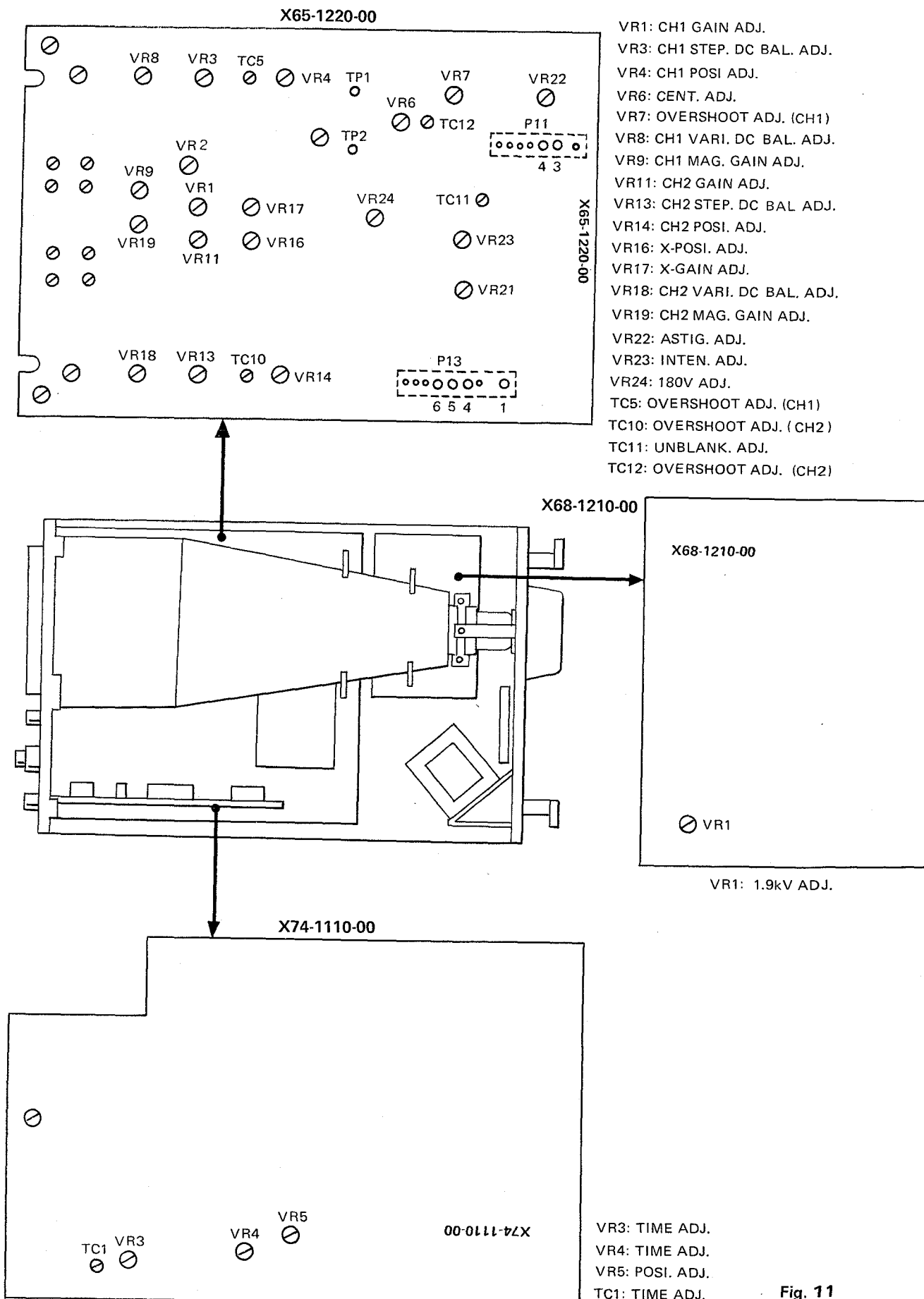
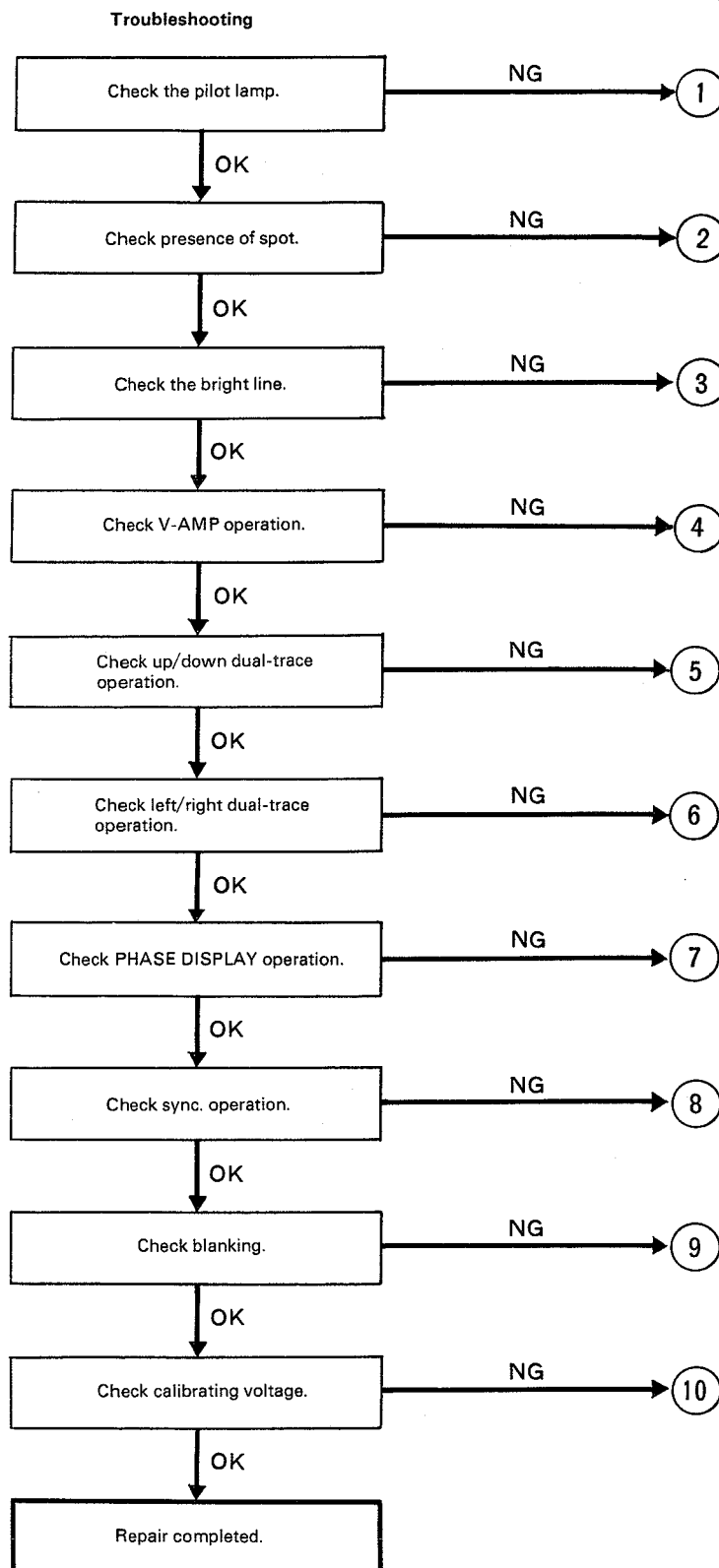
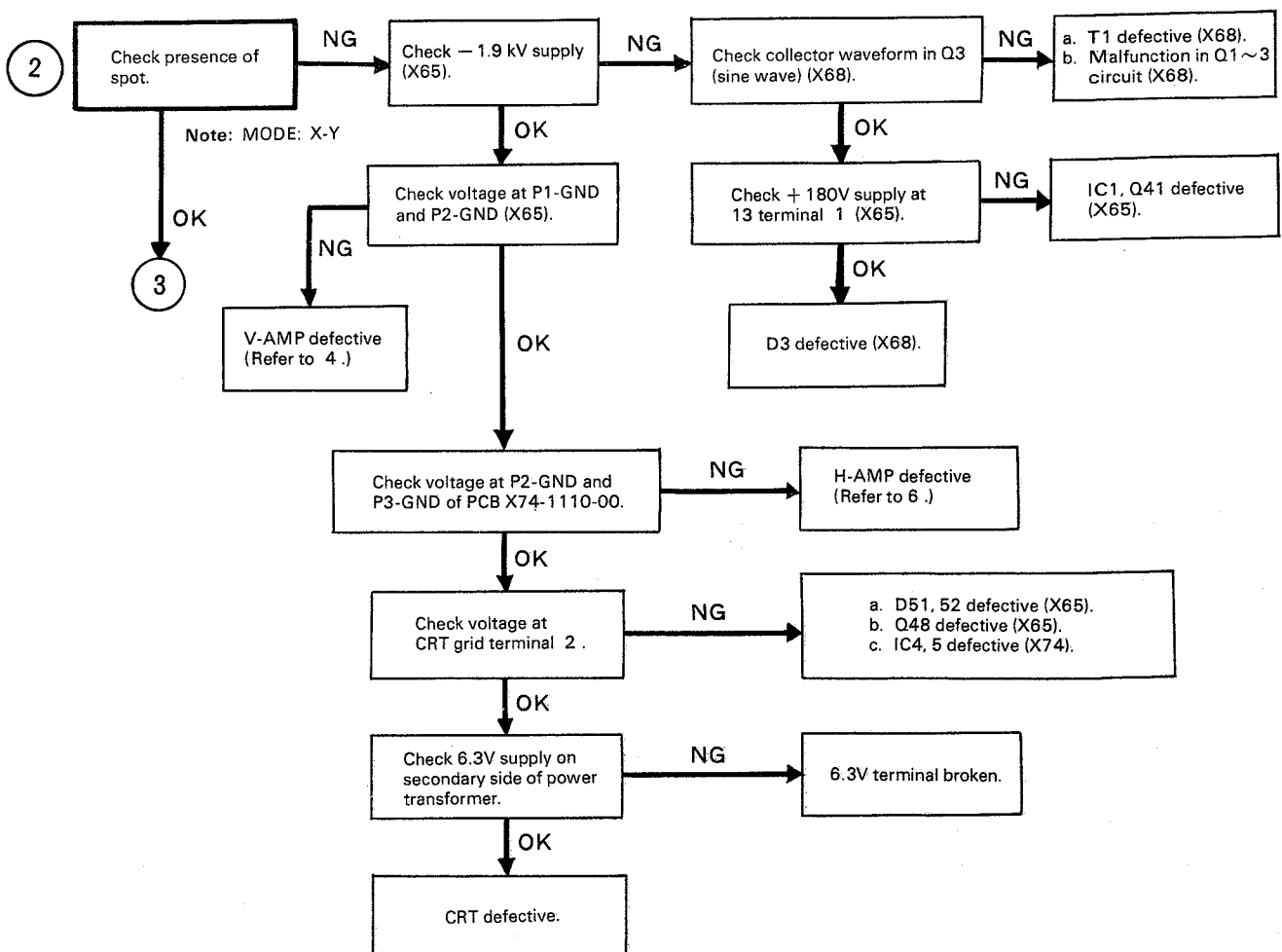
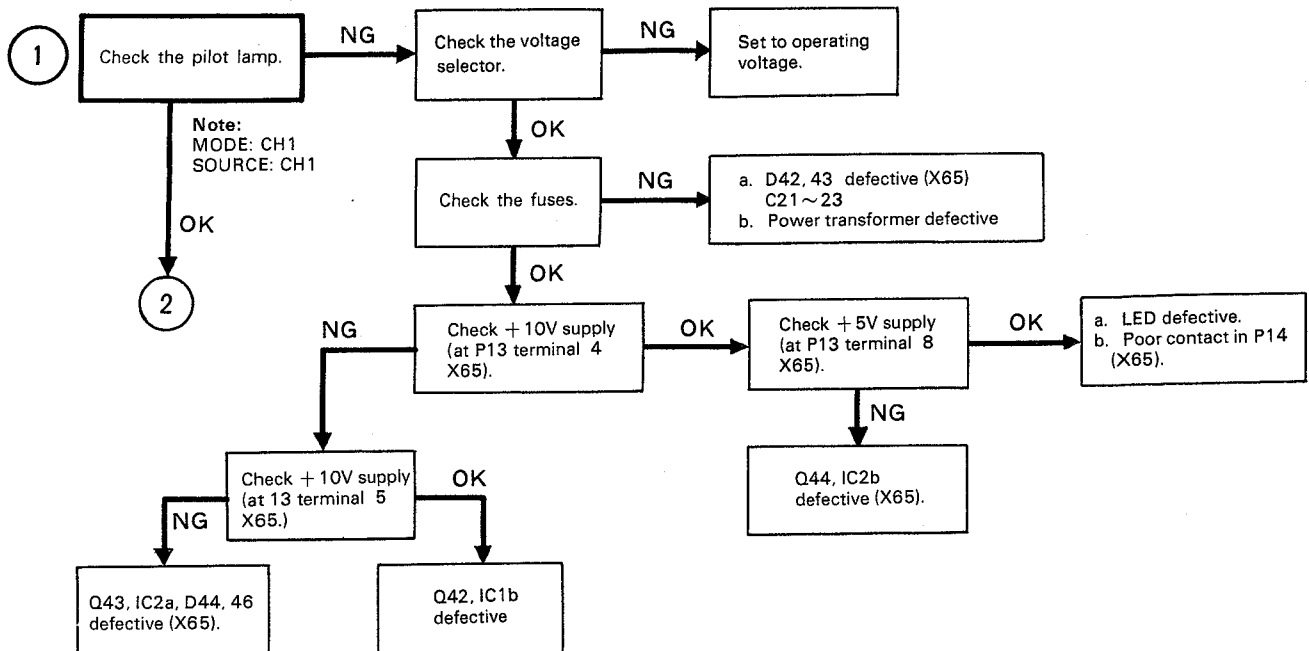
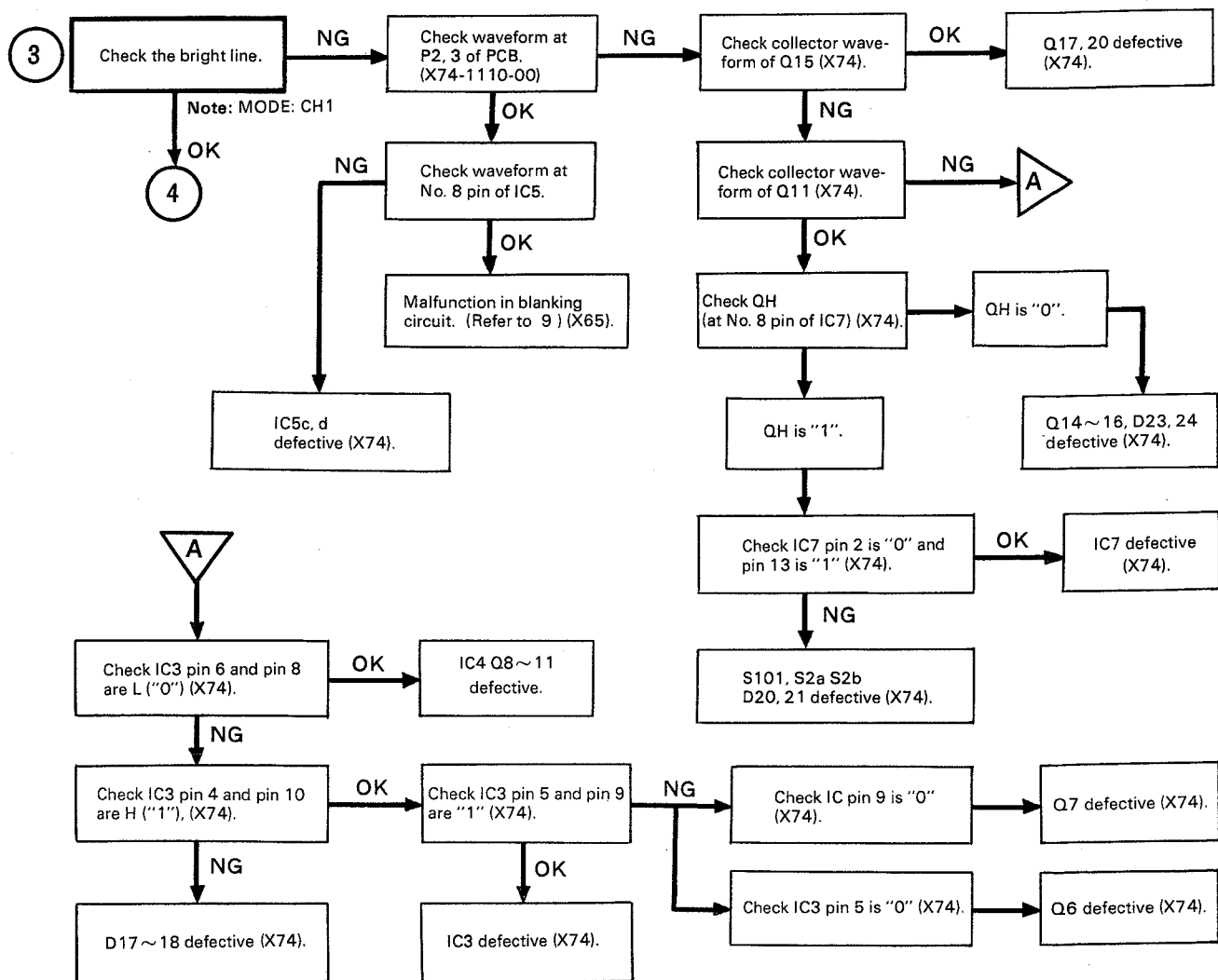


Fig. 11

TROUBLESHOOTING







Function of Mirror Integration Circuit (Fig. 12)

When no input signal is applied to the trigger amplifier, no trigger pulses will be generated and thus IC4 pin-13 is "0" and pin 11 is "1". When input signal "1" is fed to IC4 pin-10, IC4 pin-8 becomes "0" and D14 in the sweep circuit turns OFF, causing the mirror integration circuit (Q10, 11) to start operating (see "C" in Fig. 12). At this time the charge voltage is applied to the Schmidt circuit (IC4a, b) through Q8 and Q9 and when it reaches the threshold level (about 2.5V), the outputs of IC4a, b are inverted, inverting "C" of IC4 from "0" to "1".

This turns D14 to on and the voltage is discharged quickly, since D13 is OFF, the voltage charged in the hold-off capacitor through Q8 is also discharged via R42, which is fed to the Schmidt circuit through Q9, thereby inverting the output and set it to the original state.

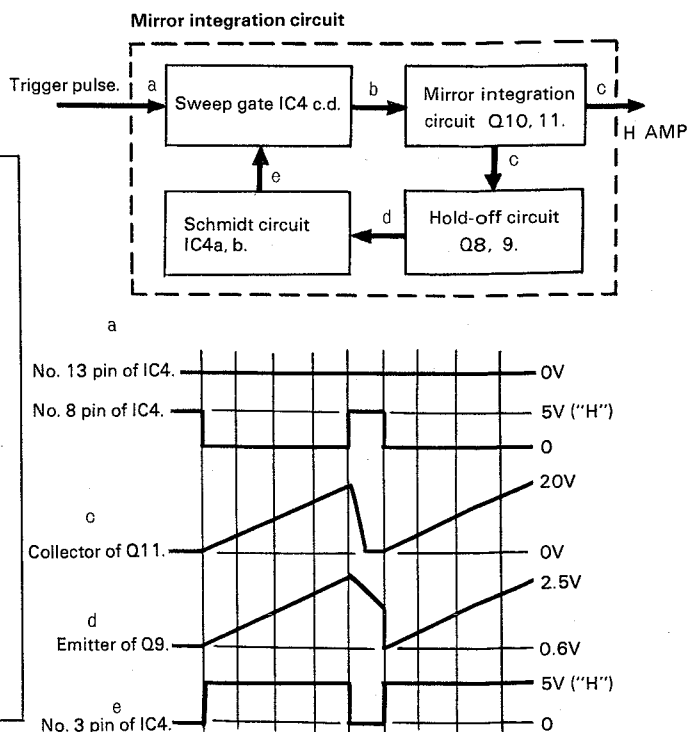


Fig. 12

* For items 4~9, check should be made with a signal applied to CH1 and CH2.

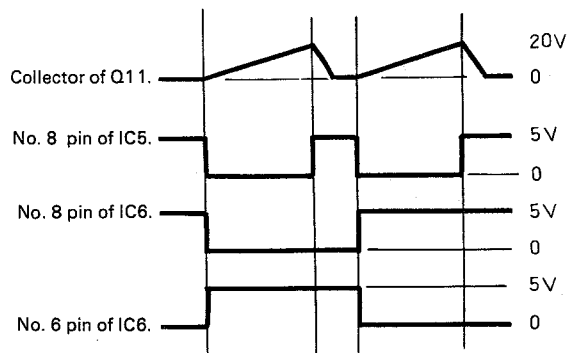
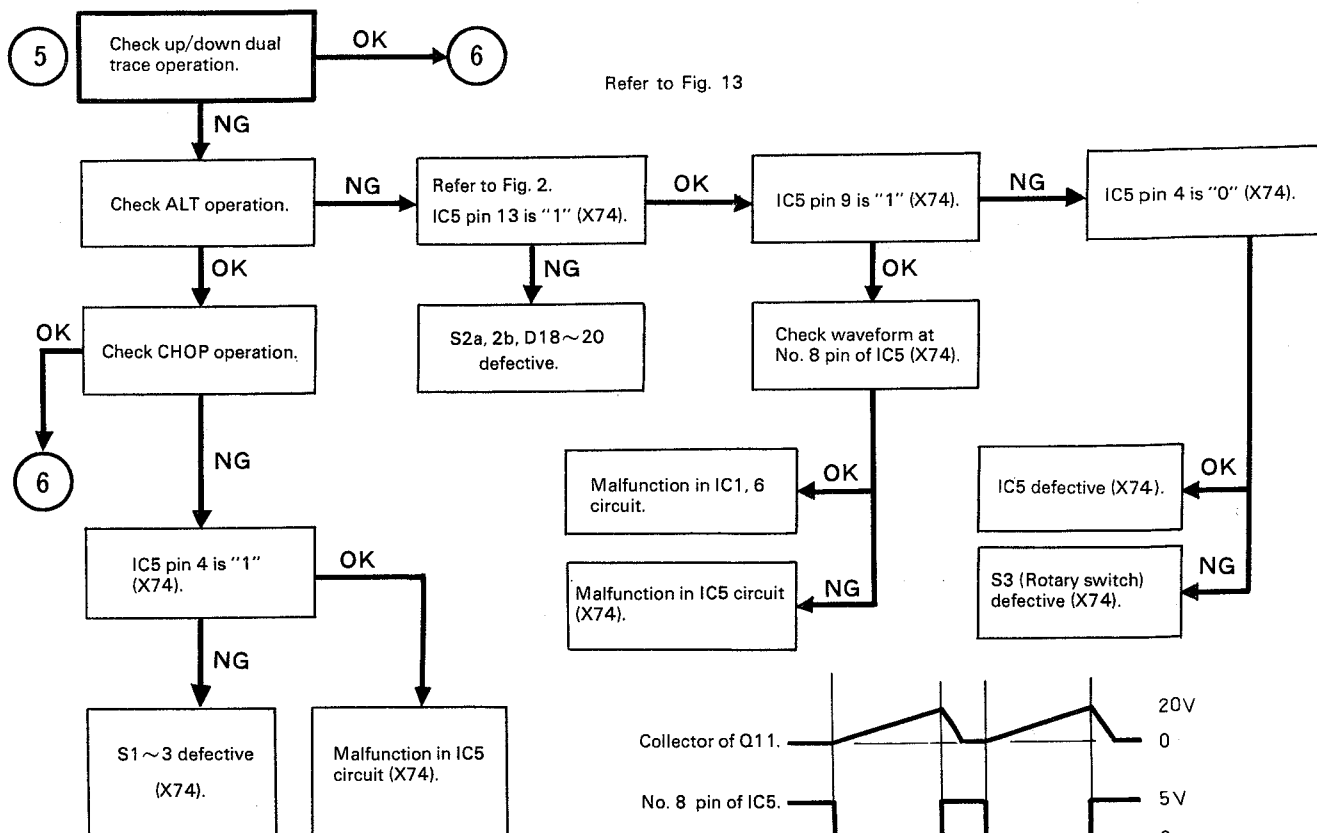
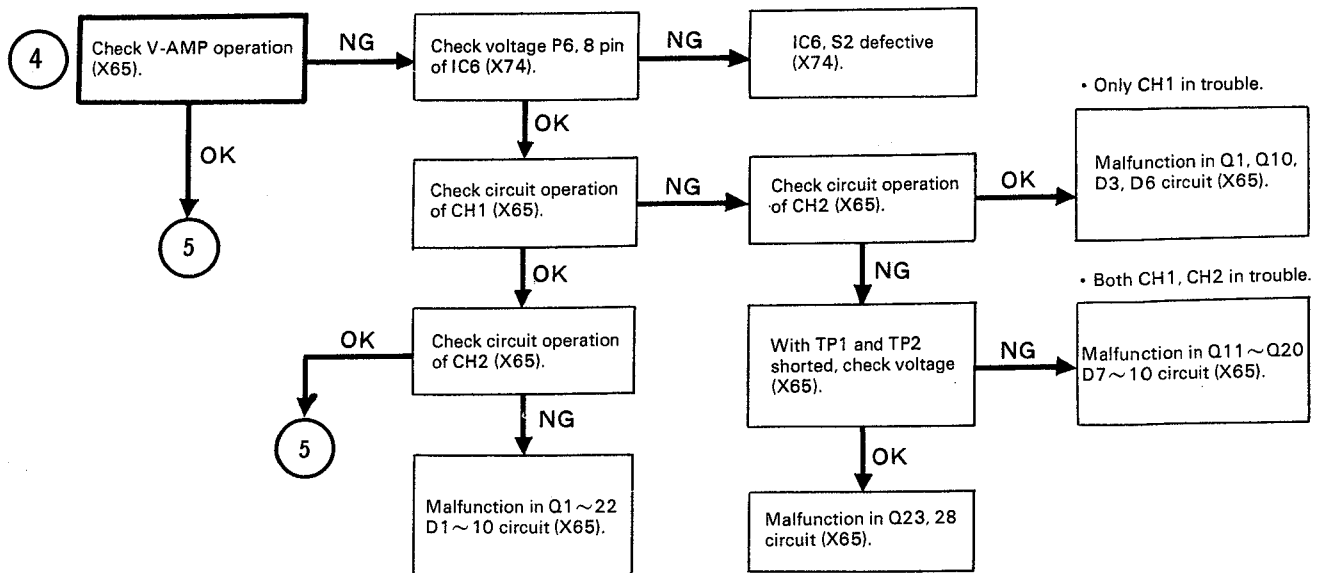


Fig. 13

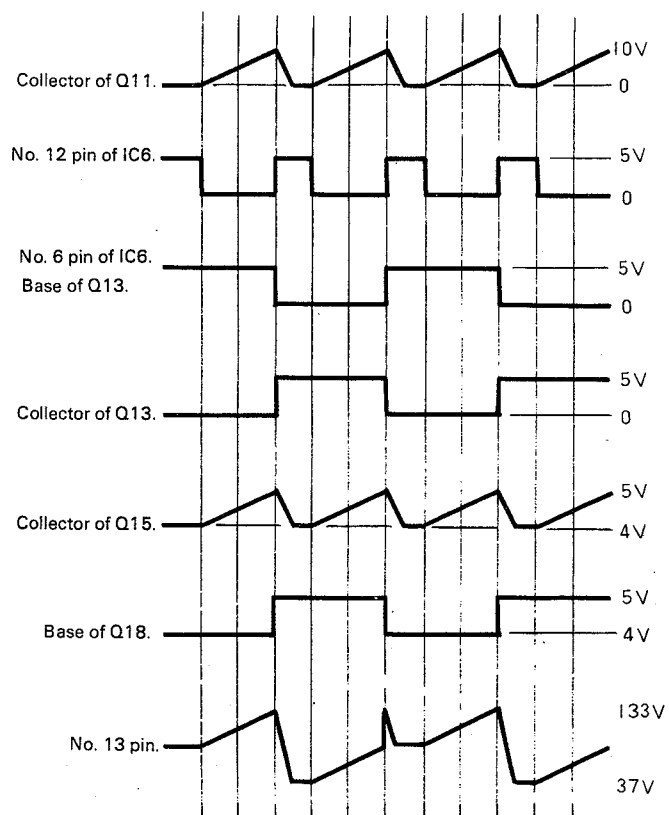
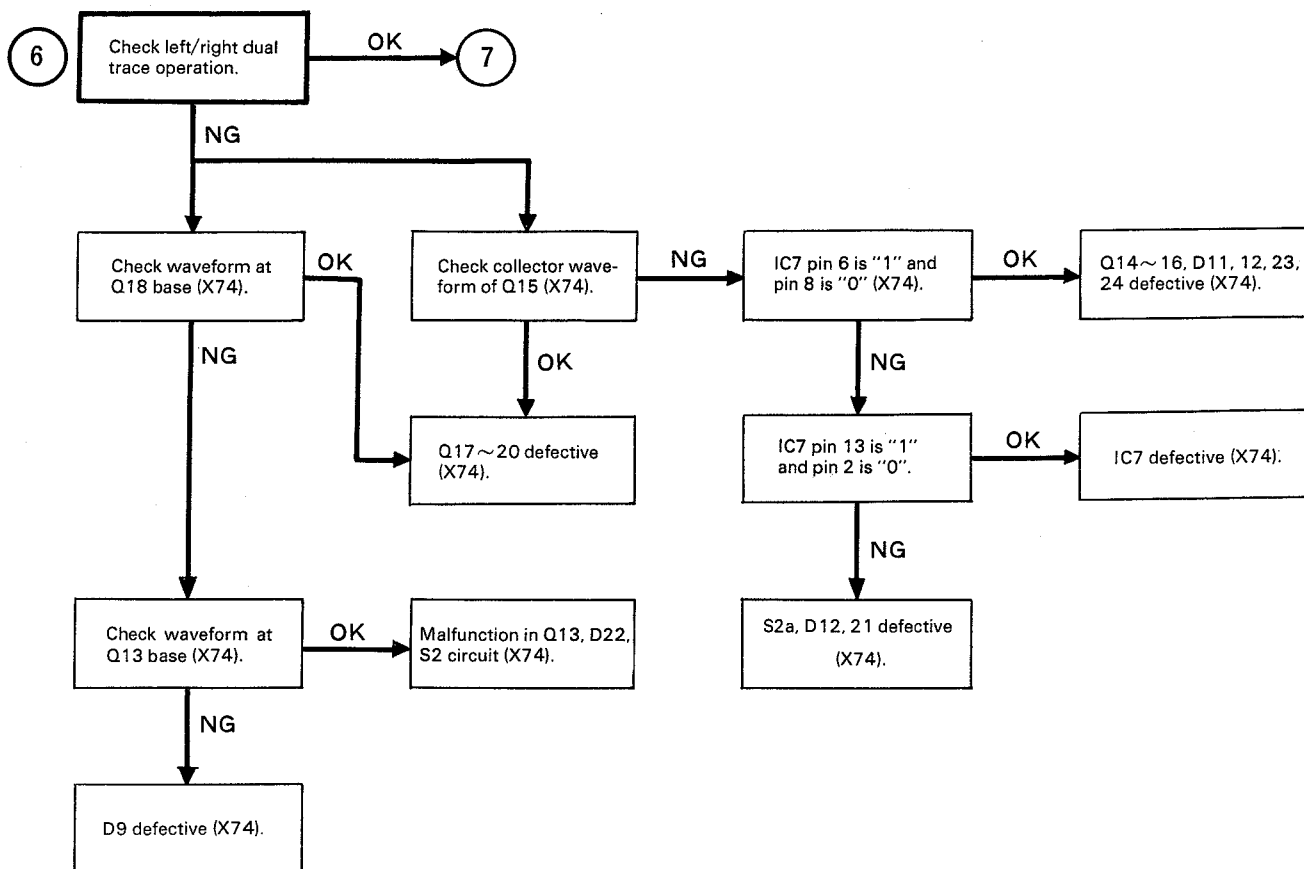


Fig. 14

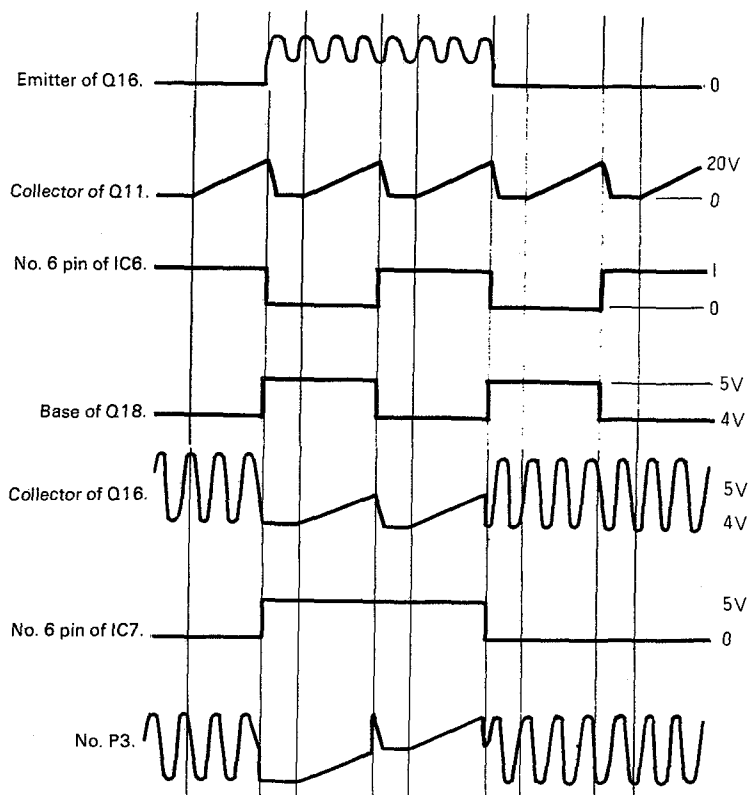
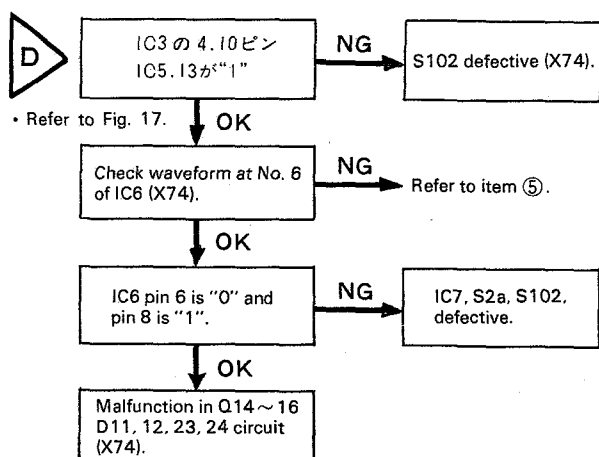
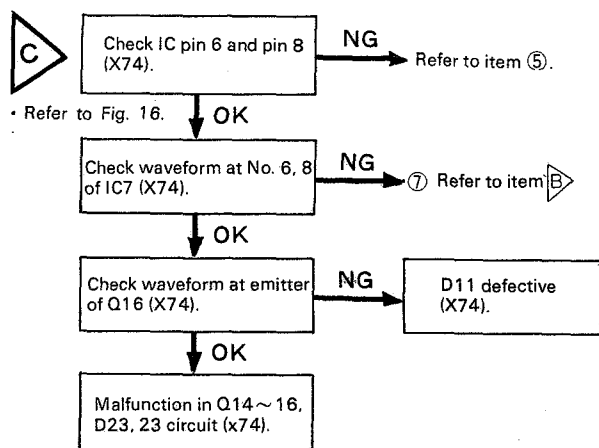
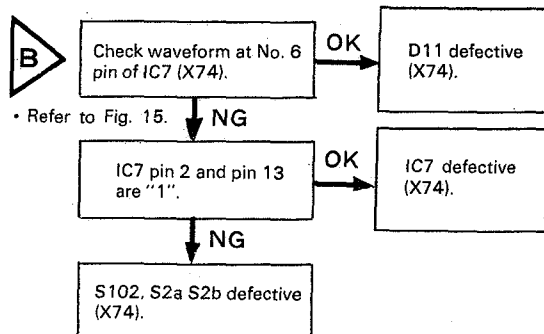
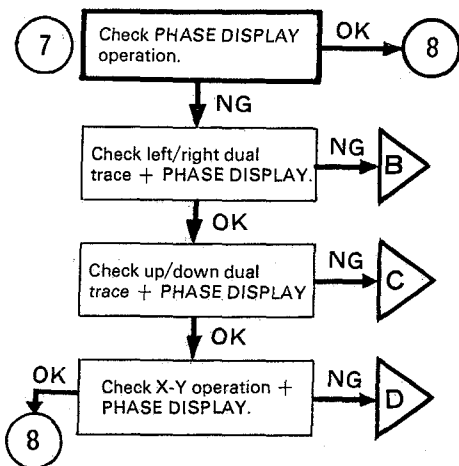


Fig. 15

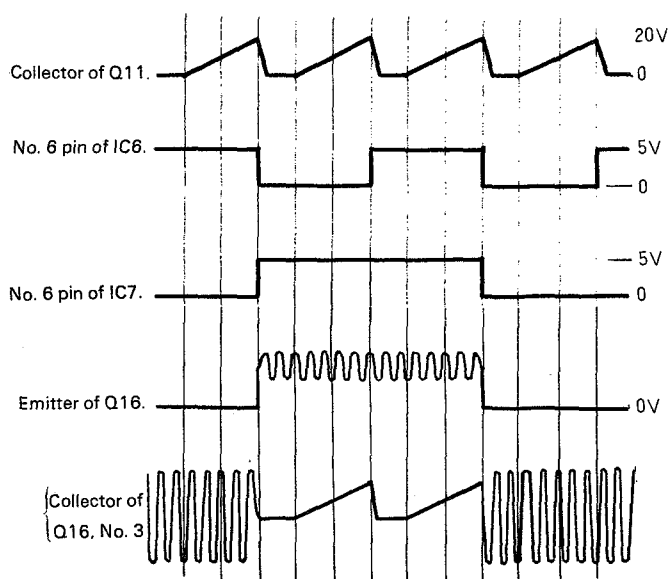


Fig. 16

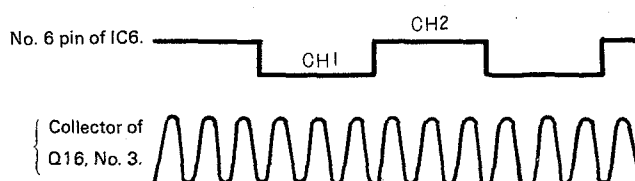


Fig. 17

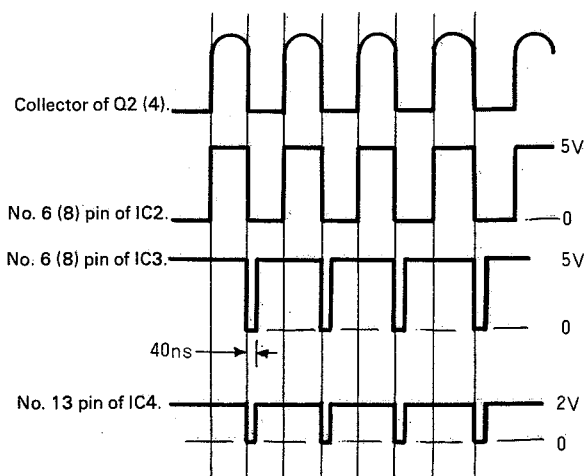
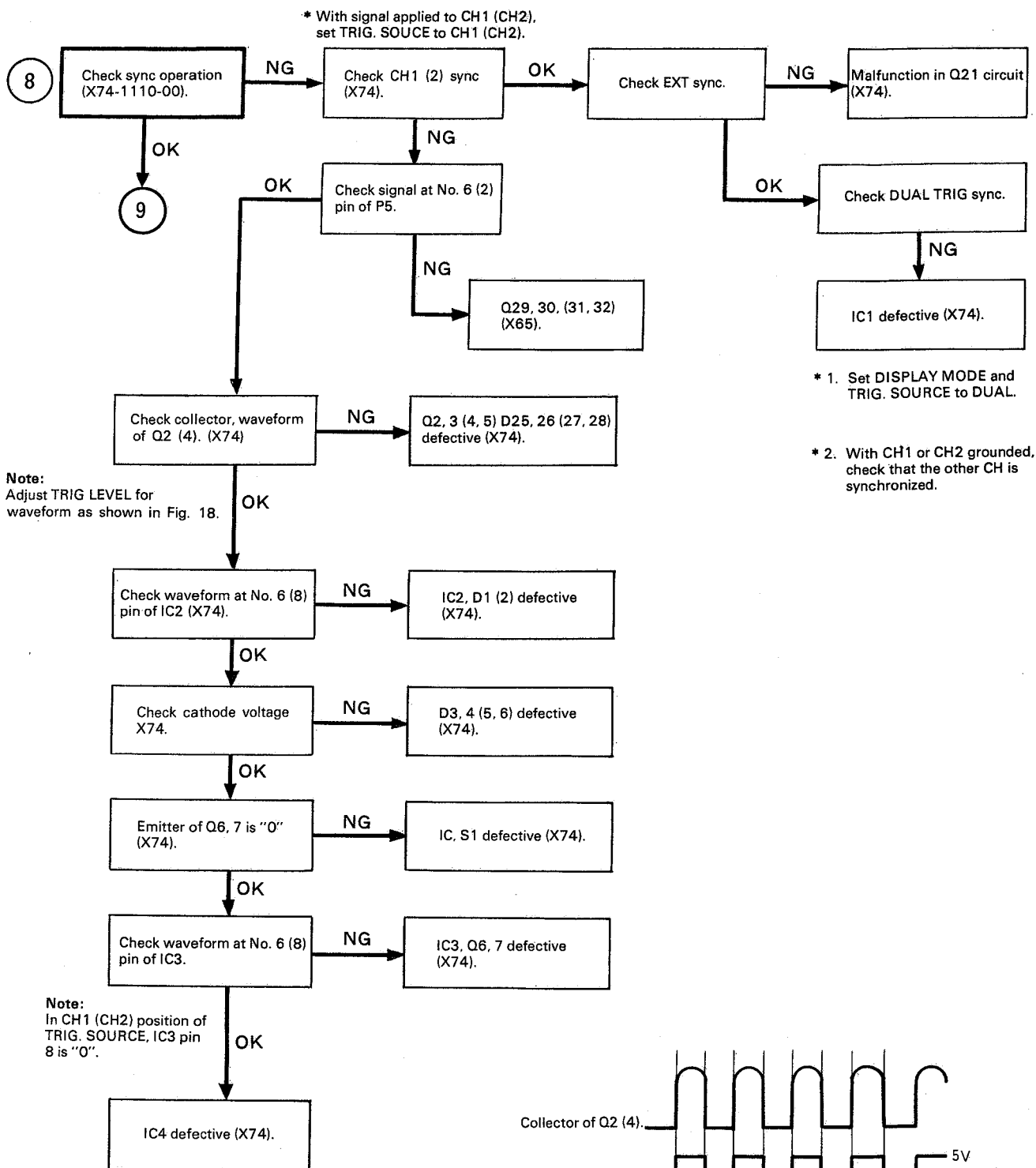


Fig. 18

* Add any signal to CH1 or CH2 EXT TRIG. terminal.

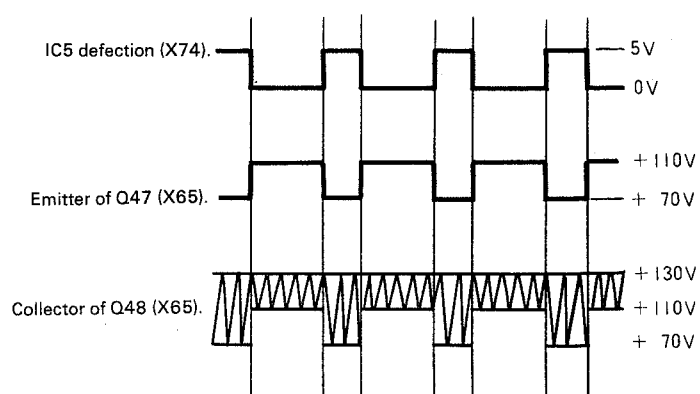
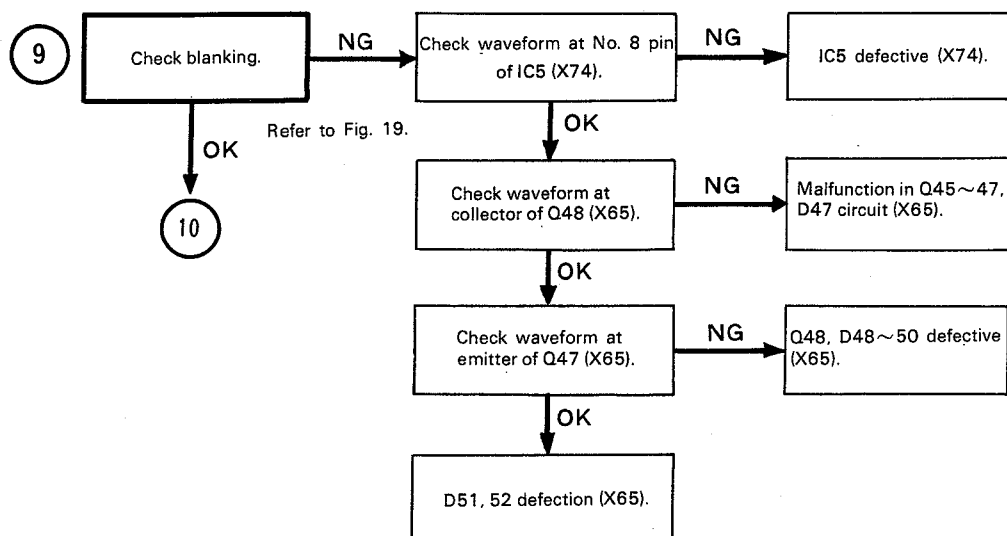
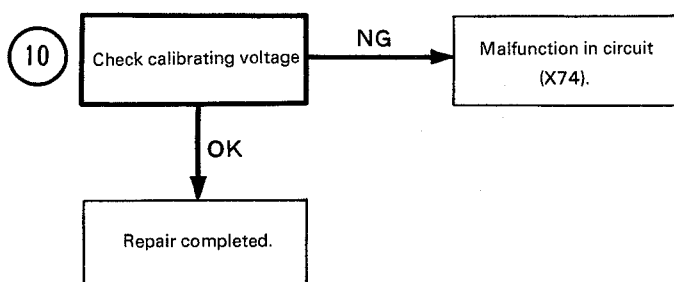
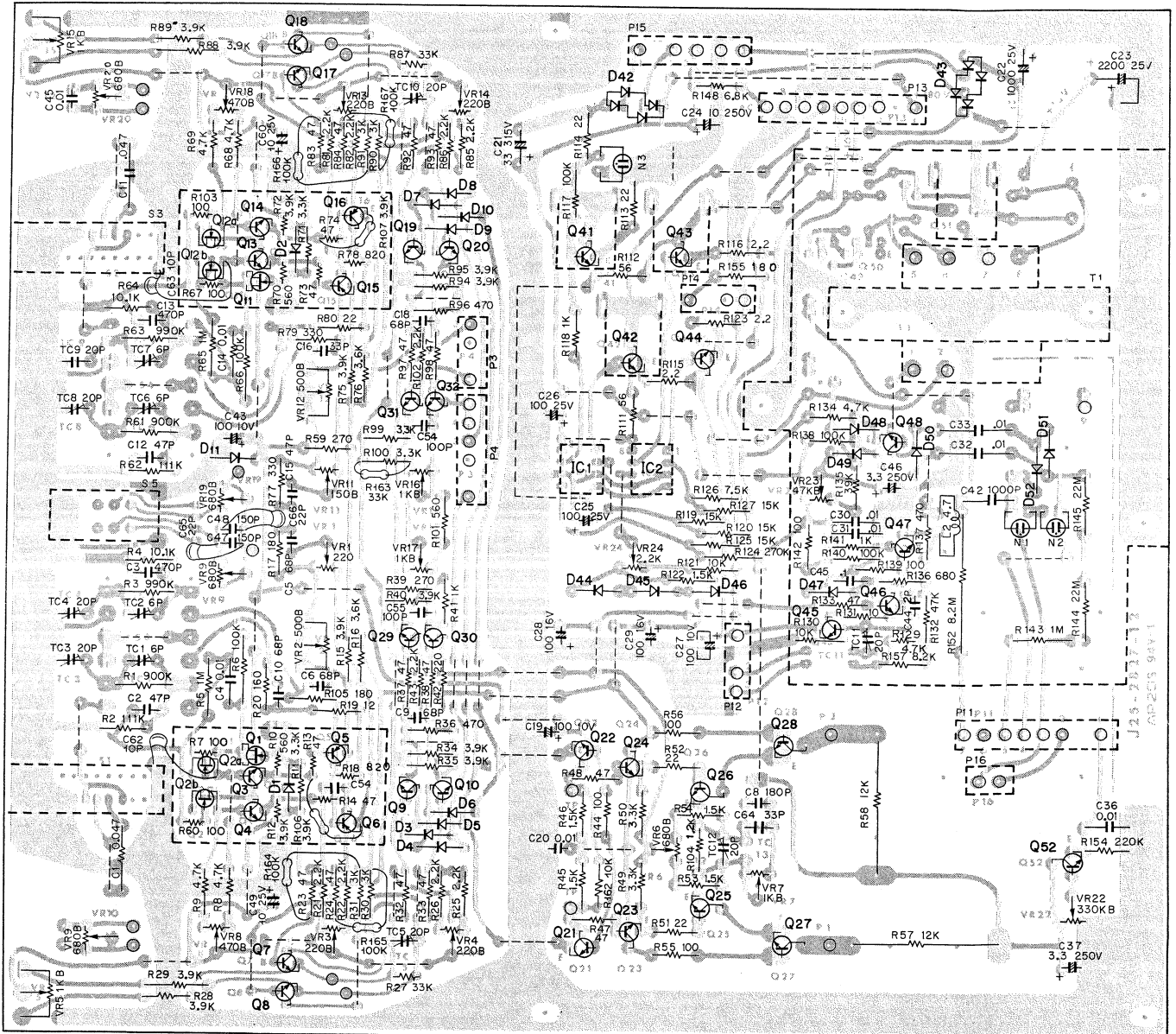


Fig. 19

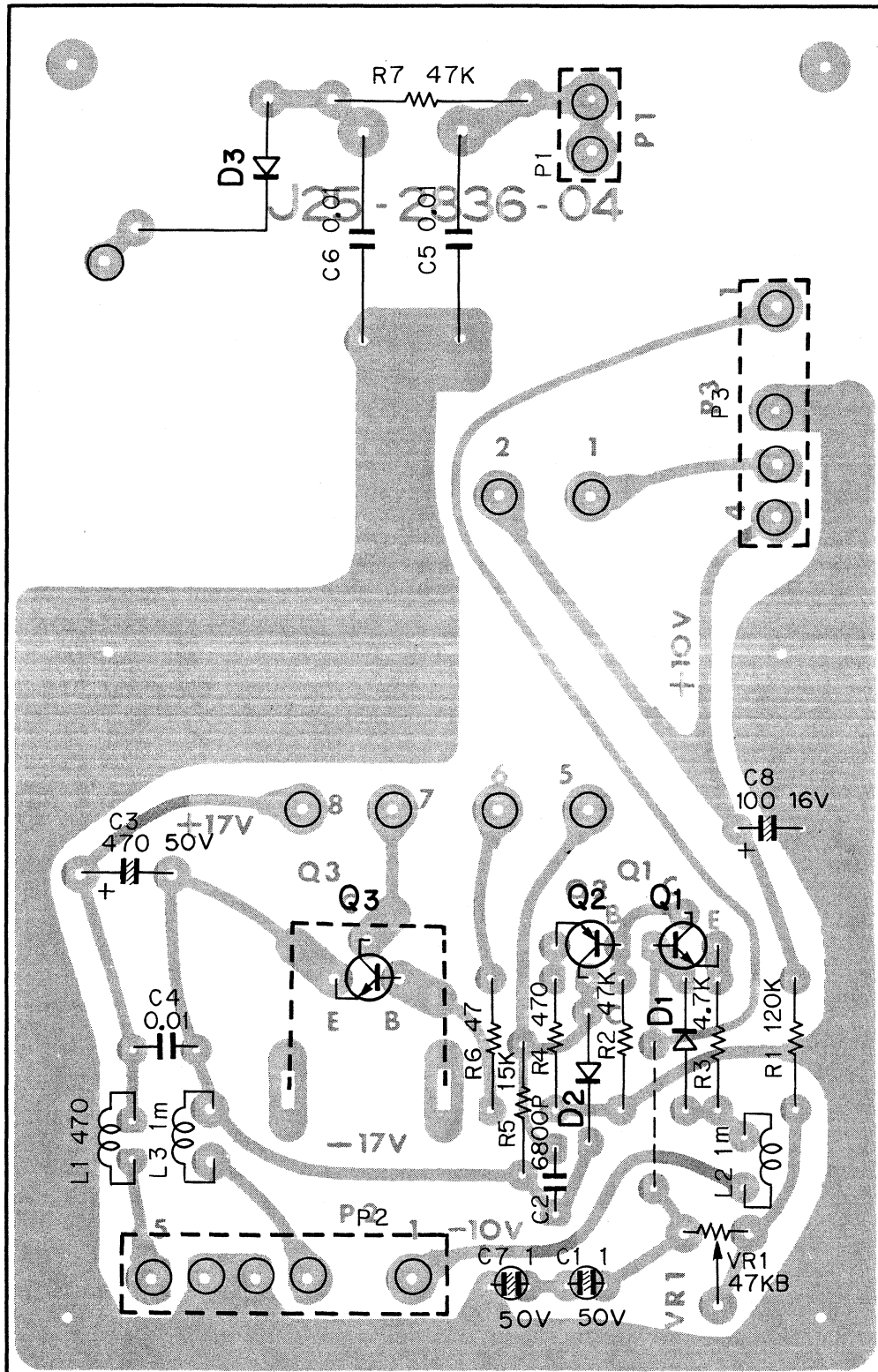


P.C. BOARD (X65-1220-00)



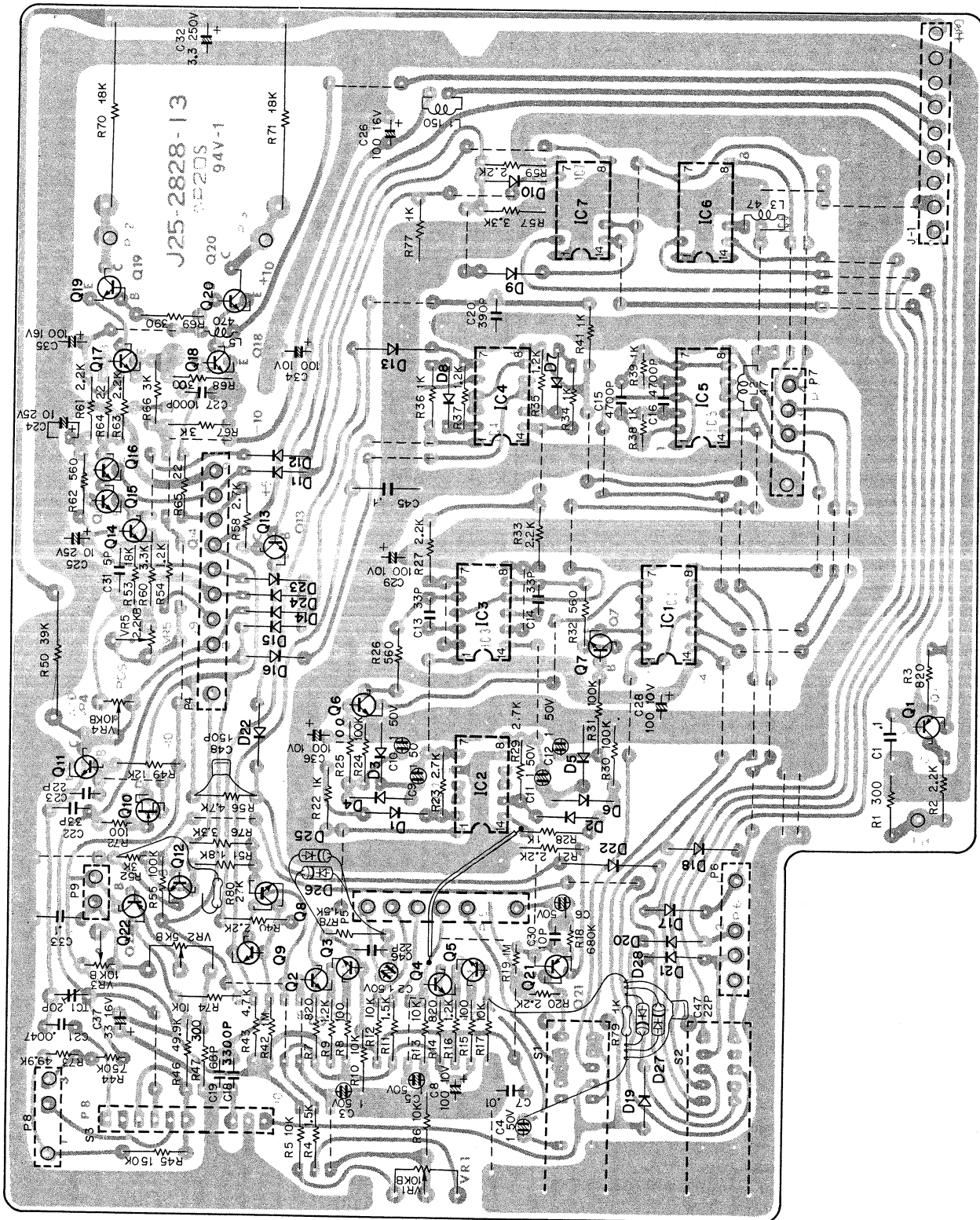
IC1a,1b, IC2a,2b:PC4558C, Q1,11:2SK30A(O), Q2a,2b,12a,12b:2SK58-1-M, Q3,4, 9J0,13,14, 19,26,29~32,46, 49:2SC945P, Q7,8,17,18:2SC945Q
 Q5,6,15,16:2SA7330, Q27,28,47:2SC2068, Q42,44:2SC1419C, Q43:2SA755C, Q45:2SC535B, Q46,48,52:2SC983Y, Q41:2SB456A
 D1~10, 45, 46, 48:1S1555, D11:YZ030, D42,43:SIQB60, D44:WZ100, D47:WZ050, D49:W06C
 D50:ISS83, D51,52:W06C

P.C. BOARD (X68-1210-00)



Q1:2SC945-P, Q2:2SA733-Q, Q3:2SD401
D1,2:1S1555, D3:Y16JA

P.C. BOARD (X74-1110-00)



IC1~5:TD3400P, IC6,7:TD3472AP, Q1,21,22:2SA733-Q, Q2~9,11~18:2SC945-P, Q10:2SK30A-O
 Q19,20:2SC2068
 D1~24:1S1555, D25~28:1N60

PARTS LIST

PARTS LIST OF Y70-1170-00

Ref. No.	Parts No.	Description
MISCELLANEOUS		
	A01-0892-02	Case
	A10-1419-02	Chassis
	A20-2718-02	Die-casting panel
	A21-0826-12	Ornamental panel
	A23-1612-02	Rear panel
	A40-0705-02	Bottom plate
	B07-0105-04	Push-escutcheon × 3
	B07-0701-04	Push-escutcheon
	B20-0901-14	Graticule
	B30-0904-15	Lamp assembly
	B40-0765-04	Name plate
	B40-2729-04	Name plate (CS-1575)
	B41-0701-04	Name plate (power source)
	B50-2849-00	Instruction manual
	E01-1403-05	CRT socket
	E03-0201-05	Power connector
	E04-0251-05	Receptacle, type BNC × 3
	E21-0654-04	Terminal, for voltage calibration
	E23-0018-04	Soldering lug
	E30-1818-05	AC power cord
J101	E31-0542-25	Lead wire w/6P + 3P connector
J102	E31-0544-15	Lead wire w/9P + 2P connector
J103	E31-0541-15	Lead wire w/4P + 3P connector
J104	E31-0543-05	Lead wire w/7P connector
J105	E31-0539-15	Lead wire w/3P connector
J109	E31-0544-15	Lead wire w/9P + 2P connector
J110	E31-0542-25	Lead wire w/6P + 3P connector
J111	E31-0540-05	Lead wire w/4P connector
J112	E31-0541-15	Lead wire w/4P + 3P connector
J113	E30-0554-15	Lead wire w/3P connector
J114	E31-0507-15	Lead wire w/4P connector
J115~		
118	E31-0509-15	Lead wire w/1P connector
J119,120	E31-0538-05	Lead wire w/1P + 1P connector
J121	E31-0532-05	Lead wire w/1P connector
J122	E31-0545-05	Lead wire w/2P connector
J123	E31-0546-05	Lead wire w/3P connector
F101	F05-3011-05	Fuse, 0.3A
	F07-0901-04	Cover
	F10-1527-04	Shielding plate
	F11-0230-13	Shielding case
	F11-0902-13	CRT shield
	F15-0186-04	Felt 170 × 10 (mm)
	F15-0701-04	Felt 420 × 20 × t2
	G02-0601-14	Spring × 2
	G13-0090-04	CRT mounting rubber × 2
	G53-0601-04	Bezel bush × 4
	H01-2833-04	Packing case
	H10-2801-03	Packing material, foamed styrene × 2
	H20-1701-24	Protection cover
	J02-0501-05	Rubber leg
	J10-0026-22	Bezel
	J10-0047-03	Bezel assembly
	J13-0033-15	Fuse holder
	J19-0457-14	CRT band (1)

Ref. No.	Parts No.	Description
	J19-0458-14	CRT band (2)
	J21-2802-04	P.C. Board mounting hardware
	J21-2805-05	Grip mounting hardware × 2
	J21-2817-14	Switch mounting hardware × 2
	J21-2848-04	VR mounting hardware
	J21-2581-03	Power transformer mounting hardware
	J61-0039-05	Wire clip × 6
	J61-0049-05	Cable wrapping band × 12
	K01-0501-05	Grip assembly
	K01-0502-05	Grip (metallic) × 2
	K01-0503-05	Grip (molded)
	K21-0259-14	Knob, 22.8φ × 3
	K21-0306-04	Knob, 17φ × 6
	K21-0801-24	Knob, 13φ × 3
	K21-0804-04	Knob, 17φ
	K21-0807-04	Knob × 3
	K29-0801-04	Knob × 4
	L01-9116-05	Power transformer
R1.2	RD14BB2E470J	Carbon resistor, 47Ω 5% 1/4W
VR101		
(S101)	R03-1021-05	Variable resistor with switch, 1kΩB
VR102	R05-8001-05	Variable resistor, 3MΩB
VR103	R01-3027-05	Variable resistor, 10kΩB
VR104,		
105	R06-1501-05	Variable resistor, 2kΩB
VR106	R01-3027-05	Variable resistor, 10kΩB
S102,103	S40-2501-05	Pushbutton-switch
		CRT, 130BE B31
	W01-0058-04	Cord winder
	X65-1220-00	Vertical, power supply unit
	X67-1020-00	BNC cord
	X68-1210-00	High voltage power supply unit
	X74-1110-00	Sweep circuit unit
	X77-1020-00	Voltage selector unit

PARTS LIST OF X65-1220-00

Ref. No.	Parts No.	Description
RESISTOR		
R1	RN14BK2H9003F	Metal film 900kΩ ±1% 1/2W
R2	RN14BK2E1113F	Metal film 111kΩ ±1% 1/4W
R3	RN14BK2H9903F	Metal film 990kΩ ±1% 1/2W
R4	RN14BK2E1012F	Metal film 10.1kΩ ±1% 1/4W
R5	RN14BK2H1004F	Metal film 1MΩ ±1% 1/2W
R6	RD14BY2H104J	Carbon 100kΩ ±5% 1/2W
R7	RD14CB2E101J	Carbon 100Ω ±5% 1/4W
R8,9	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R10	RD14CB2E561J	Carbon 560Ω ±5% 1/4W
R11	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R12	RD14CB2E392J	Carbon 3.9kΩ ±5% 1/4W
R13,14	RD14CB2E470J	Carbon 47Ω ±5% 1/4W
R15	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R16	RN14BK2E3601G	Metal film 3.6kΩ ±2% 1/4W

Ref. No.	Parts No.	Description
R17	RD14BB2E181J	Carbon 180Ω ±5% 1/4W
R18	RN14BK2E8200F	Metal film 820Ω ±1% 1/4W
R19	RD14BB2E120J	Carbon 12Ω ±5% 1/4W
R20	RN14BK2E1600F	Metal film 160Ω ±1% 1/4W
R21,22	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R23,24	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R25,26	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R27	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R28,29	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R30,31	RN14BK2E3001F	Metal film 3kΩ ±1% 1/4W
R32,33	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R34,35	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R36	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R37,38	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R39,40	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R41	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R42	RD14BB2E221J	Carbon 220Ω ±5% 1/4W
R43	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R44	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R45,46	RD14BB2E152J	Carbon 1.5kΩ ±5% 1/4W
R47,48	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R49,50	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R51,52	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R53,54	RD14BB2E152J	Carbon 1.5kΩ ±5% 1/4W
R55,56	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R57,58	RS14GB3F123J	Metal film 12kΩ ±5% 3W
R59	RD14BB2E271J	Carbon 270Ω ±5% 1/4W
R60	RD14CB2E101J	Carbon 100Ω ±5% 1/4W
R61	RN14BK2H9003F	Metal film 900kΩ ±1% 1/2W
R62	RN14BK2E1113F	Metal film 111kΩ ±1% 1/4W
R63	RN14BK2H9903F	Metal film 990kΩ ±1% 1/2W
R64	RN14BK2E1012F	Metal film 10.1kΩ ±1% 1/4W
R65	RN14BK2H1004F	Metal film 1MΩ ±1% 1/2W
R66	RD14BY2H104J	Carbon 100kΩ ±5% 1/2W
R67	RD14CB2E101J	Carbon 100Ω ±5% 1/4W
R68,69	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R70	RD14CB2E561J	Carbon 560Ω ±5% 1/4W
R71	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R72	RD14CB2E392J	Carbon 3.9kΩ ±5% 1/4W
R73,74	RD14CB2E470J	Carbon 47Ω ±5% 1/4W
R75	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R76	RN14BK2E3601G	Metal film 3.6kΩ ±2% 1/4W
R77	RD14BB2E331J	Carbon 330Ω ±5% 1/4W
R78	RN14BK2E8200F	Metal film 820Ω ±1% 1/4W
R79	RN14BK2E3300F	Metal film 330Ω ±1% 1/4W
R80	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R81,82	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R83,84	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R85,86	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R87	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R88,89	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R90,91	RN14BK2E3001F	Metal film 3kΩ ±1% 1/4W
R92,93	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R94,95	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R96	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R97,98	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R99	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R100	RD14BB2E332J	Carbon 3.3kΩ ±5% 1/4W
R101	RD14BB2E561J	Carbon 560Ω ±5% 1/4W
R102	RD14BB2E222J	Carbon 2.2kΩ ±5% 1/4W
R103	RD14CB2E101J	Carbon 100Ω ±5% 1/4W
R104	RD14BB2E122J	Carbon 1.2kΩ ±5% 1/4W
R105	RN14BK2E1800F	Metal film 180Ω ±1% 1/4W
R106,107	RD14BB2E392J	Carbon 3.9kΩ ±5% 1/4W
R111,112	RD14BB2E560J	Carbon 56Ω ±5% 1/4W

Ref. No.	Parts No.	Description
R113,114	RD14BB2E220J	Carbon 22Ω ±5% 1/4W
R115,116	RD14BB2E2R2J	Carbon 2.2Ω ±5% 1/4W
R117	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R118	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R119,120	RN14BK2E1502F	Metal film 15kΩ ±1% 1/4W
R121	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R122	RD14BB2E152J	Carbon 1.5kΩ ±5% 1/4W
R123	RD14BB2E2R2J	Carbon 2.2kΩ ±5% 1/4W
R124	RN14BK2H2703F	Metal film 270kΩ ±1% 1/2W
R125	RN14BK2E1502F	Metal film 15kΩ ±1% 1/4W
R126	RN14BK2E7501F	Metal film 7.5kΩ ±1% 1/4W
R127	RN14BK2E1502F	Metal film 15kΩ ±1% 1/4W
R129	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R130	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R131	RD14BB2E100J	Carbon 10Ω ±5% 1/4W
R132	RD14BB2E473J	Carbon 47kΩ ±5% 1/4W
R133	RD14BB2E470J	Carbon 47Ω ±5% 1/4W
R134	RD14BB2E472J	Carbon 4.7kΩ ±5% 1/4W
R135	RD14BB2E393J	Carbon 39kΩ ±5% 1/4W
R136	RD14BB2E681J	Carbon 680Ω ±5% 1/4W
R137	RD14BB2E471J	Carbon 470Ω ±5% 1/4W
R138	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R139	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R140	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
R141	RD14BB2E102J	Carbon 1kΩ ±5% 1/4W
R142	RD14BB2E101J	Carbon 100Ω ±5% 1/4W
R143	RC05GF2H105J	Solid 1MΩ ±5% 1/2W
R144,145	RC05GF2H226K	Solid 22MΩ ±10% 1/2W
R148	RD14BB2E682J	Carbon 6.8kΩ ±5% 1/4W
R152	R92-0707-05	Metal film 8.2MΩ ±5% 1W
R154	RD14BB2E224J	Carbon 220kΩ ±5% 1/4W
R155	RD14BB2E181J	Carbon 180Ω ±5% 1/4W
R157	RD14BB2E822J	Carbon 8.2kΩ ±5% 1/4W
R162	RD14BB2E103J	Carbon 10kΩ ±5% 1/4W
R163	RD14BB2E333J	Carbon 33kΩ ±5% 1/4W
R164~167	RD14BB2E104J	Carbon 100kΩ ±5% 1/4W
VR1	R12-0509-05	Semi-fixed resistor 220ΩB
VR2	R01-0503-05	Variable resistor 500ΩB
VR3,4	R12-0509-05	Semi-fixed resistor 220ΩB
VR5	R01-1013-25	Variable resistor 1kΩB
VR6	R12-0510-05	Semi-fixed resistor 680ΩB
VR7	R12-1002-05	Semi-fixed resistor 1kΩB
VR8	R12-0003-05	Semi-fixed resistor 470ΩB
VR9	R12-0510-05	Semi-fixed resistor 680ΩB
VR11	R12-0509-05	Semi-fixed resistor 220ΩB
VR12	R01-0503-05	Variable resistor 500ΩB
VR13,14	R12-0509-05	Semi-fixed resistor 220ΩB
VR15	R01-1013-25	Variable resistor 1kΩB
VR16,17	R12-1002-05	Semi-fixed resistor 1kΩB
VR18	R12-0003-05	Semi-fixed resistor 470ΩB
VR19	R12-0510-05	Semi-fixed resistor 680ΩB
VR22	R12-6005-05	Semi-fixed resistor 330kΩB
VR23	R12-3004-05	Semi-fixed resistor 47kΩB
VR24	R12-1003-05	Semi-fixed resistor 2.2kΩB
CAPACITOR		
C1	C91-0501-05	Metalized film 0.047μF
C2	CM93BD2A470J	Mica 47pF ±5%
C3	CM93BD2A471J	Mica 470pF ±5%
C4	C91-0502-05	Metalized film 0.01μF
C5,6	CC45CH1H680J	Ceramic 68pF ±5%
C8	CC45CH1H181J	Ceramic 180pF ±5%
C9,10	CC45CH1H680J	Ceramic 68pF ±5%

Ref. No.	Parts No.	Description
C11	C91-0501-05	Metalized film 0.047 μ F
C12	CM93BD2A470J	Mica 47pF $\pm$ 5%
C13	CM93BD2A471J	Mica 470pF $\pm$ 5%
C14	C91-0502-05	Metalized film 0.01 μ F
C15	CC45CH1H470J	Ceramic 47pF $\pm$ 5%
C16	CC45CH1H330J	Ceramic 33pF $\pm$ 5%
C18	CC45CH1H680J	Ceramic 68pF $\pm$ 5%
C19	CE04W1A101	Electrolytic 100 μ F 10WV
C20	C90-0298-05	Semiconductor ceramic 0.01 μ F +80%, -20%
C21	CE04W2F330	Electrolytic 33 μ F 315WV
C22	CE04W1E102	Electrolytic 1000 μ F 25WV
C23	CE04W1E222	Electrolytic 2200 μ F 25WV
C24	CE04W2E100	Electrolytic 10 μ F 250WV
C25,26	CE04W1E101	Electrolytic 100 μ F 25WV
C27	CE04W1A101	Electrolytic 100 μ F 10WV
C28,29	CE04W1C101	Electrolytic 100 μ F 16WV
C30,31	CK45D2H103M	Ceramic 0.01 μ F 20%
C32,33	CK45E3D103P	Ceramic 0.01 μ F +100%, -0%
C36	CK45D2H103M	Ceramic 0.01 μ F 20%
C37	CE04W2E3R3	Electrolytic 3.3 μ F 250WV
C42	CK45E3D102P	Ceramic 1000pF +100%, -0%
C43	CE04W1A101	Electrolytic 100 μ F 10WV
C44	CC45CH2H020C	Ceramic 2pF $\pm$ 0.25pF
C45	C90-0298-05	Semiconductor ceramic 0.01 μ F +80%, -20%
C46	CE04W2E3R3	Electrolytic 3.3 μ F 250WV
C47,48	CC45CH1H151J	Ceramic 150pF $\pm$ 5%
C49	CE04W1E100	Electrolytic 10 μ F 25WV
C54,55	CC45CH1H101J	Ceramic 100pF $\pm$ 5%
C60	CE04W1E100	Electrolytic 10 μ F 25WV
C62,63	CC45CH1H100D	Ceramic 10pF $\pm$ 0.5pF
C64	CC45CH1H330J	Ceramic 33pF $\pm$ 5%
C65,66	CC45CH1H220J	Ceramic 22pF $\pm$ 5%
TC1,2	C05-0403-05	Ceramic trimmer 6pF
TC3~5	C05-0405-05	Ceramic trimmer 20pF
TC6,7	C05-0403-05	Ceramic trimmer 6pF
TC8~12	C05-0405-05	Ceramic trimmer 20pF
SEMICONDUCTOR		
IC1a,1b, IC2a,2b		IC, Linear μ PC4558C
Q1		Transistor Field effect 2SK30A(O)
Q2a,2b		Transistor Dual field effect 2SK58-1-M or N
Q3,4		Transistor 2SC945P
Q5,6		Transistor 2SA733Q
Q7,8		Transistor 2SC945Q
Q9,10		Transistor 2SC945P
Q11		Transistor Field effect 2SK30A(O)
Q12a,12b		Transistor Dual field effect 2SK58-1-M or N
Q13,14		Transistor 2SC945P
Q15,16		Transistor 2SA733Q
Q17,18		Transistor 2SC945Q
Q19~26		Transistor 2SC945P
Q27,28		Transistor 2SC2068
Q29~32		Transistor 2SC945P
Q41		Transistor 2SB546A
Q42		Transistor 2SC1419C
Q43		Transistor 2SA755C
Q44		Transistor 2SC1419C
Q45		Transistor 2SC535B

Ref. No.	Parts No.	Description
Q46		Transistor 2SC983Y
Q47		Transistor 2SC2068
Q48		Transistor 2SC983Y
Q49		Transistor 2SC945P
Q52		Transistor 2SC983Y
D1~10		Diode 1S1555
D11		Diode, Zener YZ030
D42,43		Diode, Bridge S1QB60
D44		Diode, Zener WZ100
D45,46		Diode 1S1555
D47		Diode, Zener WZ050
D48		Diode 1S1555
D49		Diode W06C
D50		Diode 1SS83
D51,52		Diode W06C
MISCELLANEOUS		
N1~3		Neon lamp NE-2
P1,2	E23-0047-04	Terminal
P3	E40-0503-05	Connector
P4	E40-0303-05	Connector
P11	E40-0703-05	Connector
P12	E40-0303-05	Connector
P13	E40-0936-05	Connector
P14	E40-0303-05	Connector
P15	E40-0532-05	Connector
P16	E40-0201-05	Connector
TP1,2	E23-0508-04	Connector
	F01-0231-14	Heat sink
	F10-1526-04	Shielding plate $\times$ 2
	F11-0147-24	Shielding case $\times$ 2
	J25-2827-12	Printed circuit board
L2	L40-4791-02	Inductor, Fixed, Small 4.7 μ H
S1	S32-4007-05	Lever switch
S2	S03-4501-05	Rotary switch
S3	S32-4007-05	Lever switch
S4	S03-4501-05	Rotary switch
S5	S40-2502-05	Pushbutton switch

PARTS LIST OF X68-1210-00

Ref. No.	Parts No.	Description
RESISTOR		
R1	RD14BB2E124J	Carbon 120k Ω $\pm$ 5% 1/4W
R2	RD14BB2E473J	Carbon 47k Ω $\pm$ 5% 1/4W
R3	RD14BB2E472J	Carbon 4.7k Ω $\pm$ 5% 1/4W
R4	RD14BB2E471J	Carbon 470 Ω $\pm$ 5% 1/4W
R5	RD14BB2E153J	Carbon 15k Ω $\pm$ 5% 1/4W
R6	RD14BB2E470J	Carbon 47 Ω $\pm$ 5% 1/4W
R7	RC05GF2H473J	Solid 47k Ω $\pm$ 5% 1/2W
VR1	R12-3035-05	Semi-fixed resistor 47k Ω B

Ref. No.	Parts No.	Description
CAPACITOR		
C1	CE04BW1H010M	Electrolytic, Non-polar 1 μ F 50WV
C2	CQ93M1H682K	Mylar 6800 μ F $\pm$ 10%
C3	CE04W1H471	Electrolytic 470 μ F 50WV
C4	CK45F1H103Z	Ceramic 0.01 μ F +100%, -0%
C5,6	CK45D3D103P	Ceramic 0.01 μ F +100%, -0%
C7	CE04BW1H010M	Electrolytic, Non-polar 1 μ F 50WV
C8	CE04W1C101	Electrolytic 100 μ F 16WV
SEMICONDUCTOR		
Q1		Transistor 2SC945-P
Q2		Transistor 2SA733-Q
Q3		Transistor 2SD401
D1,2		Diode 1S1555
D3		Diode Y16JA
MISCELLANEOUS		
J1	E31-0574-15	Lead wire with connector
J2	E31-0575-05	Lead wire with connector
J3	E31-0576-05	Lead wire with connector
P1	E40-0201-05	Connector
P2	E40-0503-06	Connector
P3	E40-0403-05	Connector
	F01-0231-14	Heat sink
	F11-0927-03	Shielding case
	F20-0603-04	Insulating sheet
	F20-0604-04	Insulating sheet
	J25-2836-04	Printed circuit board
	J42-0002-05	Rubber bush $\times$ 2
	J61-0049-05	Cable wrapping band $\times$ 2
	J61-0052-05	Board support $\times$ 4
T1	L19-0019-05	Transformer, Converter
L1	L40-4711-03	Inductor, Fixed, Small 470 μ H
L2,3	L40-1025-04	Inductor, Fixed, Small 1mH

PARTS LIST OF X74-1110-00

Ref. No.	Parts No.	Description
RESISTOR		
R1	RN14BK2E3000F	Metal film 300 Ω $\pm$ 1% 1/4W
R2	RN14BK2E2201F	Metal film 2.2k Ω $\pm$ 1% 1/4W
R3	RD14BB2E821J	Carbon 820 Ω $\pm$ 5% 1/4W
R4	RD14BB2E152J	Carbon 1.5k Ω $\pm$ 5% 1/4W
R5,6	RD14BB2E103J	Carbon 10k Ω $\pm$ 5% 1/4W
R7	RD14BB2E821J	Carbon 820 Ω $\pm$ 5% 1/4W
R8	RD14BB2E101J	Carbon 100 Ω $\pm$ 5% 1/4W
R9	RD14BB2E122J	Carbon 1.2k Ω $\pm$ 5% 1/4W
R10	RD14BB2E103J	Carbon 10k Ω $\pm$ 5% 1/4W
R11	RD14BB2E152J	Carbon 1.5k Ω $\pm$ 5% 1/4W
R12,13	RD14BB2E103J	Carbon 10k Ω $\pm$ 5% 1/4W
R14	RD14BB2E821J	Carbon 820 Ω $\pm$ 5% 1/4W
R15	RD14BB2E101J	Carbon 100 Ω $\pm$ 5% 1/4W
R16	RD14BB2E122J	Carbon 1.2k Ω $\pm$ 5% 1/4W
R17	RD14BB2E103J	Carbon 10k Ω $\pm$ 5% 1/4W
R18	RD14CB2E684J	Carbon 680k Ω $\pm$ 5% 1/4W
R19	RD14CB2E105J	Carbon 1M Ω $\pm$ 5% 1/4W
R20	RD14CB2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W

Ref. No.	Parts No.	Description
R21	RD14BB2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W
R22	RD14BB2E102J	Carbon 1k Ω $\pm$ 5% 1/4W
R23	RD14BB2E272J	Carbon 2.7k Ω $\pm$ 5% 1/4W
R24,25	RD14BB2E104J	Carbon 100k Ω $\pm$ 5% 1/4W
R26	RD14BB2E561J	Carbon 560 Ω $\pm$ 5% 1/4W
R27	RD14BB2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W
R28	RD14BB2E102J	Carbon 1k Ω $\pm$ 5% 1/4W
R29	RD14BB2E272J	Carbon 2.7k Ω $\pm$ 5% 1/4W
R30,31	RD14BB2E104J	Carbon 100k Ω $\pm$ 5% 1/4W
R32	RD14BB2E561J	Carbon 560 Ω $\pm$ 5% 1/4W
R33	RD14BB2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W
R34	RD14BB2E102J	Carbon 1k Ω $\pm$ 5% 1/4W
R35	RD14BB2E122J	Carbon 1.2k Ω $\pm$ 5% 1/4W
R36	RD14BB2E102J	Carbon 1k Ω $\pm$ 5% 1/4W
R37	RD14BB2E122J	Carbon 1.2k Ω $\pm$ 5% 1/4W
R38,39	RD14CB2E102J	Carbon 1k Ω $\pm$ 5% 1/4W
R40	RD14BB2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W
R41	RD14BB2E102J	Carbon 1k Ω $\pm$ 5% 1/4W
R42	RD14BB2E105J	Carbon 1M Ω $\pm$ 5% 1/4W
R43	RD14BB2E472J	Carbon 4.7k Ω $\pm$ 5% 1/4W
R44	RN14BK2H7503F	Metal film 750k Ω $\pm$ 1% 1/2W
R45	RN14BK2E1503F	Metal film 150k Ω $\pm$ 1% 1/4W
R46	RN14BK2E4992F	Metal film 49.9k Ω $\pm$ 1% 1/4W
R47	RN14BK2E9100F	Metal film 399 Ω $\pm$ 1% 1/4W
R49	RD14BB2E123J	Carbon 12k Ω $\pm$ 5% 1/4W
R50	RS14GB3D393J	Metal film 39k Ω $\pm$ 5% 1/4W
R51	RN14BK2E1801F	Metal film 1.8k Ω $\pm$ 1% 1/4W
R52	RN14BK2E3001F	Metal film 3k Ω $\pm$ 1% 1/4W
R53	RD14BB2E183J	Carbon 18k Ω $\pm$ 5% 1/4W
R54	RD14BB2E122J	Carbon 1.2k Ω $\pm$ 5% 1/4W
R55	RD14BB2E104J	Carbon 100k Ω $\pm$ 5% 1/4W
R56	RD14BB2E472J	Carbon 4.7k Ω $\pm$ 5% 1/4W
R57	RD14BB2E332J	Carbon 3.3k Ω $\pm$ 5% 1/4W
R58	RD14BB2E272J	Carbon 2.7k Ω $\pm$ 5% 1/4W
R59	RD14BB2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W
R60	RD14BB2E332J	Carbon 3.3k Ω $\pm$ 5% 1/4W
R61	RD14BB2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W
R62	RD14BB2E561J	Carbon 560 Ω $\pm$ 5% 1/4W
R63	RD14BB2E222J	Carbon 2.2k Ω $\pm$ 5% 1/4W
R64,65	RD14BB2E220J	Carbon 22 Ω $\pm$ 5% 1/4W
R66,67	RN14BK2E3001G	Metal film 3k Ω $\pm$ 5% 1/4W
R68	RN14BK2E3000G	Metal film 300 Ω $\pm$ 2% 1/4W
R69	RD14BB2E391J	Carbon 390 Ω $\pm$ 5% 1/4W
R70,71	RS14GB3F183J	Metal film 18k Ω $\pm$ 5% 3W
R72	RD14CB2E101J	Carbon 100 Ω $\pm$ 5% 1/4W
R73	RN14BK2E4992F	Metal film 49.9k Ω $\pm$ 1% 1/4W
R74	RD14BB2E103J	Carbon 1k Ω $\pm$ 5% 1/4W
R76	RD14BB2E332J	Carbon 3.3k Ω $\pm$ 5% 1/4W
R77	RD14BB2E102J	Carbon 1k Ω $\pm$ 5% 1/4W
R78	RD14BB2E152J	Carbon 1.5k Ω $\pm$ 5% 1/4W
R79	RD14BB2E102J	Carbon 1k Ω $\pm$ 5% 1/4W
R80	RD14BB2E273J	Carbon 27k Ω $\pm$ 5% 1/4W
VR1	R01-2503-05	Variable resistor 10k Ω B
VR2	R01-2501-05	Variable resistor 5k Ω B
VR3,4	R12-3002-05	Semi-fixed resistor 10k Ω B
VR5	R12-1003-05	Semi-fixed resistor 2.2k Ω B
CAPACITOR		
C1	C90-0298-00	Semiconductor ceramic 0.1 μ F +80%, -20%
C2~6	CE04BW1H010M	Electrolytic, Non-polar 1 μ F 50WV
C7	CK45F1H103Z	Ceramic 0.01 μ F +80%, -20%
C8	CE04W1A101	Electrolytic 100 μ F 10WV
C9~12	CE04BW1H010M	Electrolytic, Non-polar 1 μ F 50WV

PARTS LIST OF X77-1020-00

Ref. No.	Parts No.	Description
C13,14	CC45CH1H330J	Ceramic 33pF $\pm 5\%$
C15,16	CQ93M1H472K	Mylar 4700pF $\pm 10\%$
C17	CC45SL1H151J	Ceramic 150pF $\pm 5\%$
C18	CK45B1H332K	Ceramic 3300pF $\pm 10\%$
C19	CC45CH1H680J	Ceramic 68pF $\pm 5\%$
C20	CK45B1H391K	Ceramic 390pF $\pm 10\%$
C21	C91-0516-05	Film 0.0047 μ F
C22	CM93BD2A330J	Mica 33pF $\pm 5\%$
C23	CC45SL1H220J	Ceramic 22pF 5%
C24,25	CE04W1E100	Electrolytic 10 μ F 25WV
C26	CE04W1C101	Electrolytic 100 μ F 16WV
C27	CK45B1H102K	Ceramic 1000pF $\pm 10\%$
C28,29	CE04W1A101	Electrolytic 100 μ F 10WV
C30	CC45SL1H100D	Ceramic 10pF ± 0.5 pF
C31	CC45CH1H050D	Ceramic 5pF ± 0.5 pF
C32	CE04W2E3R3	Electrolytic 3.3 μ F 250WV
C33	C90-0298-05	Semiconductor ceramic 0.1 μ F +80%, -20%
C34	CE04W1A101	Electrolytic 100 μ F 10WV
C35	CE04W1C101	Electrolytic 100 μ F 16WV
C36	CE04W1A101	Electrolytic 100 μ F 10WV
C37	CE04W1C330	Electrolytic 33 μ F 16WV
C45	CQ93M1H104K	Mylar 0.1 μ F $\pm 10\%$
C46,47	CC45SL1H220J	Ceramic 22pF $\pm 5\%$
C48	CC45SL1H151J	Ceramic 150pF $\pm 5\%$
TC1	C05-0405-05	Ceramic trimmer 20pF
SEMICONDUCTOR		
IC1~IC5		IC, Digital TD3400AP
IC6,7		IC, Digital TD3472AP
Q1		Transistor 2SA733 (Q)
Q2~9		Transistor 2SC945 (P)
Q10		Transistor, Field effect 2SK30A (O)
Q11~18		Transistor 2SC945 (P)
Q19,20		Transistor 2SC2068
Q21,22		Transistor 2SA733 (Q)
D1~24		Diode 1S1555
D25~28		Diode 1N60
MISCELLANEOUS		
P1~3	E23-0047-04	Terminal
P4	E40-0903-05	Connector
P5	E40-0603-05	Connector
P6,7	E40-0403-05	Connector
P8	E40-0303-05	Connector
P9	E40-0201-05	Connector
J1	E40-0906-05	Connector
	J25-2828-13	Printed circuit board
L1	L40-1511-03	Inductor, Fixed, Small 150 μ H
L2,3	L40-4701-03	Inductor, Fixed, Small 47 μ H
L5	L40-4711-03	Inductor, Fixed, Small 470 μ H
S1a,1b	S37-2005-05	Lever switch
S2a,2b	S33-2501-05	Lever switch
S3a~3d	S03-2501-05	Rotary switch

Ref. No.	Parts No.	Description
MISCELLANEOUS		
	E08-1081-05	Voltage selector, Receptacle
	E09-0681-05	Voltage selector, Plug
	E40-0233-05	Connector, 2P
	E40-0533-05	Connector, 5P
	E40-0635-05	Connector, 6P
	F19-0703-04	Patch for voltage selector
	J12-0501-14	Mold pin
	J21-2824-04	Selector mounting hardware
	J25-2805-14	Printed circuit board

The schematic diagram illustrates the internal circuitry of a Tektronix 510 oscilloscope, organized into several functional sections:

- Input Section (X65-1220-00):** This section handles the input signals, including CH1 and CH2 inputs, and provides initial signal conditioning and amplification.
- Trigger Section (X74-1110-00):** This section manages the triggering of the oscilloscope, including trigger level setting, trigger source selection, and trigger pulse generation.
- Display Section (X68-1210-00):** This section controls the display, including display mode selection (CH1, CH2, DUAL, X-Y, PHASE), display intensity, and display position.
- Power Section (X77-1020-00):** This section provides the power supply for the oscilloscope, including a power transformer, power filter, and power regulation.

The schematic includes numerous components, including transistors, diodes, resistors, capacitors, and integrated circuits, all interconnected to form the complete oscilloscope circuit. A list of component values and part numbers is provided at the bottom of the diagram.

Component List:

- Q1,11: 2SK30A-0
- Q2,12: 2SK58-1-M
- Q3,4,9,10,13,14,19,20: 21~25,29~32: 2SC945(P)
- Q5,6,15,16: 2SA733(Q)
- Q27,28: 2SC2068
- Q7,8,17,18: 2SC9450
- D1~10: 1S1555
- D11: YZ030
- Q45: 2SC535(B)
- Q46,48,52: 2SC945(P)
- Q47: 2SC2068
- Q49: 2SC945(P)
- D47: WZ-050
- D48: 1S1555
- D49,51,52: W06C
- D50: 1S583
- Q41: 2SB546A
- Q42,44: 2SC1419(C)
- Q43: 2SA755(C)
- D44: WZ-100
- D45,46: 1S1555
- IC1,2: μ PC4558C
- IC1~5: TD3400AP
- IC6,7: TD3472AP
- IC1~5: CP 43 K2 K1 0
- D1~24: 1N60
- D25~28: 1N60
- IC1~5: TD3400AP
- IC6,7: TD3472AP
- Q1,21,22: 2SA733(Q)
- Q2~9,11~18: 2SC945(P)
- Q19,20: 2SC2068
- Q10: 2SK30A-0
- D1~24: 1S1555
- D25~28: 1N60
- IC1~5: TD3400AP
- IC6,7: TD3472AP